MET PRO CORPORATION

Duall Division

ELECTRONIC CHROME & GRINDING

Duall 9026

Operation & Maintenance Manual

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OPERATION & MAINTENANCE MANUAL

Project: Electronic Chrome & Grinding
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April 16, 1998

HEXMASTER/RETRO-HEX CHROME SCRUBBER

INSTALLATION, OPERATION & MAINTENANCE INSTRUCTIONS

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CONDITIONS OF PERFORMANCE GUARANTEE

Duall will only guarantee the performance of the HEXMASTER/RETRO-HEX chrome scrubber after formal inspection of all existing system components (e.g., scrubber, fan, exhaust ducting, drainage piping, washdown piping, stack, etc.). Cleaning, upgrading, and replacement of components upstream of the HEXMASTER/RETRO-HEX may be required. Replacement of all components downstream of the HEXMASTER/RETRO-HEX will be required before a performance guarantee can be offered. Performance guarantee is contingent upon proper storage, installation, and maintenance in accordance with Duall Operation & Maintenance Instructions 221-37. Performance testing must occur within 30 days of start-up or 90 days from shipment, whichever occurs first, to comply with the conditions of Duall's performance guarantee.

HANDLING AND STORAGE

1. Before proceeding with the assembly or operation of the system, read and understand these instructions.

2. Inspect all equipment when it is received. Notify carrier and Duall if any damage has occurred during shipment. No material or equipment may be returned without our prior written consent which, if given, will include shipping instructions that must be followed.

3. When unloading or moving equipment take care to prevent injury to personnel or damage to equipment.

    a. If equipment is on a skid, use a fork lift with forks that span the full length of the skid.

    b. If using a crane or similar lifting device, use a spreader bar. Provide only vertical force on lifting lugs provided.

4. Open crates and unpack the equipment carefully. Plastic components can be damaged if not handled properly.

5. Consult our prints, submittals, and scope of supply when checking for completeness of delivered items.

6. If equipment is stored before installation:

    a. Store in a clean, dry, safe area.

    b. Protect from direct sunlight. Use a reflective covering and arrange it in such a manner that air is allowed to circulate around the equipment in order to protect it from excessive heat and moisture.

c. Cover flanges and couplings in order to prevent accumulation of dirt and moisture in the unit.

d. Periodically rotate shafts on equipment like fans and pumps in order to protect bearings.

INSTALLATION

1. Remove crating materials and other debris from within components before assembly.

2. Do not apply excessive force when tightening bolts on any plastic flanges. No more than 15 ft-lbs of torque should be applied.

3. Do not tighten threaded plastic fittings more than one-and-one-half turns past hand-tight, since excessive force will damage threads. Use a strap wrench rather than a Stilson type wrench.

4. Make sure that all electrical work is done in accordance with applicable codes.

5. Do not crowd equipment. Leave room for maintenance personnel to gain access, and for removal of mist eliminator cartridges.

6. Locate the equipment near service utilities such as water, sewer, and electrical power. Make sure that the area is properly drained and that the scrubber drain connection is above the liquid level of the receiving body in order not to hinder gravity drainage.

7. Place the vessel on a sturdy, level surface which uniformly supports the base of the vessel. The surface must be free of debris in order to prevent damage to the vessel's bottom. It should also extend beyond the outline of the vessel by at least twelve (12) inches in order to accommodate anchoring. The units must be level and plumb in order to prevent liquid distribution problems.

8. Grout or shim under hold-down flanges or lugs to prevent applying excessive stress to the vessel when anchor bolts are tightened.

9. Attach sections together using gaskets and hardware provided. Take care that alignment marks match (e.g. A-A) and that flange covers (if any) have been removed.

10. Connect drain line to the scrubber. Heat trace if necessary to protect from freezing. Ensure that no flow obstructions which will disrupt operation exist.

    Drain fittings must be isolated from each other. Use a plumber's P-trap or submerge the end of each drain line. The depth of the trap (normally approximately 12 inches) will

depend upon the shut-off static pressure of the fan. Either method will prevent air from flowing in the drain line. Incorrect trapping can cause by-passing within the scrubber, or they can interfere with proper drainage of the scrubber. If traps are used make certain they are full prior to operating the scrubber. Failure to fill the traps will cause the scrubber to hold up cleaning solution. Refer to Duall's scrubber drawing for this particular project for minimum P-trap depth.

11. Connect spray washdown couplings to a fresh water supply that can deliver the required flow and pressure at the spray nozzles as indicated on the fabrication drawing. Proper washdown of the unit is critical to performance. Be sure to include valves, flow meters, and pressure gauges as shown on the drawings. Heat trace if necessary to protect from freezing. Use of hard water (more than 100 ppm by weight as calcium carbonate) during washdown could cause the media to become fouled with mineral deposits. Problems can be avoided with the installation of a water softener for the washdown water.

12. Connect tubing from pressure taps on the scrubber to the differential pressure gauges. The low pressure line is that which is on the down stream side of the scrubber or scrubber outlet. The high pressure line is that which is on the up stream side or scrubber inlet. Support lines to prevent collapse which could result in misleading readings. With no air f low, adjust each gauge to the zero mark. See instructions for the particular type of gauge being supplied.

13. Connect power lines for fan to a control panel or motor control center. Make sure that motors are wired for the correct supply voltage. Provide ample motor protection and other safety devices.

14. Connect duct to the equipment. Anchor and support the duct in order to prevent damage to the components. For duct made from PVC or other thermoplastic materials, follow guidelines provided by the Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) in their publication entitled Thermoplastic Duct Construction Manual.

15. Connect power lines to the disconnect switch in the control panel or motor control center. On three-phase systems, check rotation.

16. Check system for leaks (both air and water) or other operating problems, and correct them.

PRINCIPLE OF OPERATION

Aerosols are removed from the air stream by impaction with the elements of the scrubber media. Water is used periodically to flush the media to keep them clean. Proper flow and pressure of the wash system are critical to system performance. A regular wash schedule must be established and kept to prevent excessive fouling and system malfunction.

Proper air velocity through the unit is critical to performance of the Hexmaster/Retro-Hex. Velocity is directly related to air flow rate. The unit must operate within + 5% of its rated air flow in cubic feet per minute (CFM). Removal efficiency is dependent on particulate size and density as well as the velocity of air through the scrubber. It increases with greater particle size and density. Too low air velocity will reduce collection efficiency, while too high air velocity will cause re-entrainment of droplets. It is the responsibility of the owner to have the airflow rate through the unit verified by a professional Air Balancing firm immediately after start-up.

OPERATING LOG

Duall recommends that you maintain a record of operating data in order to facilitate troubleshooting and to ensure that proper maintenance is done at regular intervals. This data should be collected daily. A sample operating log follows this manual.
The Operator should record:

1. Air flow rate (velometer reading)
2. Air pressure drop
3. Washdown frequency
4. Washdown flow rate and/or nozzle pressure
5. Comments regarding operation or any changes in procedure
6. Date and time of these observations

PRE-STARTUP CHECKLIST

The tasks on this check list must be completed by the installer before scheduling start-up of equipment.

1. Packing and mist eliminator installed properly
2. Spray headers and spray nozzles installed
3. Washdown water piped to scrubber
4. Plumbing connections made and leak tested
5. Duct connections made and leak tested
6. Fan motor wired to correct voltage
7. Fan rotation correct
8. All fan accessories installed
9. Ductwork completely installed
10. All dampers operating properly
11. All existing equipment must be thoroughly cleaned and free of all chrome deposits, with particular emphasis on all ducting down stream of Hexmaster (including fan and stack).
12. Verify that unit is properly trapped as previously described.

SYSTEM START-UP AND OPERATION

1. Fill all P-traps in the scrubber system with water to prevent air by-passing the unit and to allow proper drainage during operation. This is done by breaking the union and pouring about a pint of water into the line. Traps must be maintained full during operation at all times.

2. Open dampers in the exhaust system and start the fan. Check to ensure that it is running properly. Adjust dampers to produce the desired flow rate. A velometer (pitot tube with Magnehelic differential pressure gauge) indicates flow rate according to the formula:

   Flow Rate (CFM) = Velocity (FPM) * Duct Area (SQFT)

   Do <u>not</u> operate the unit unless air flow is $\pm$ 5% of design.

SYSTEM SHUT DOWN

1. Turn off fan.

2. Washdown all media stages with clean water for 5 to 10 minutes.

3. Drain the traps when the weather is freezing and/or downtime is expected to be long.

MAINTAINING EQUIPMENT

Except for components that need periodic lubrication, preventative maintenance is not required for the scrubber system. Daily inspection of the system is encouraged in order that corrective maintenance, as outlined below, is not postponed.

<u>Liquid Distributor</u>

Spray nozzles should be inspected after the first week of operation and monthly thereafter. The spray pattern should be uniform and cover a full 360° arc in order to prevent problems related to poor liquid distribution. Also inspect nozzles for accumulation of scale or slime.

To correct a defective spray pattern, stop flow to the unit, remove the header and clean each affected nozzle. Depending on the condition of the nozzle, chemical or mechanical cleaning may be necessary. Replace the header and resume operation, making sure that the defects are corrected.

Mist Eliminators

The media in these scrubbers requires only intermittent washdown. Doors are provided to allow visual inspection of the elements. Inspect the final mist eliminator each month for accumulation of chrome sludge. Do not wash down the final mist eliminator when the exhaust fan is running.

During normal washdown of the first two stages, the spray is operated for one minute every eight (8) hours. The procedure requires approximately 1/4 gpm per square foot of pad area and does not require that the fan be off. Every application is different and may require an adjustment to the wash down rate and frequency.

Use of hard water (more than 100 ppm by weight as calcium carbonate) during washdown could cause the media to become fouled with mineral deposits. Problems can be avoided with regular cleaning as described below, or by installation of a water softener for the wash down water.

The quality of plant air can become an issue with pad fouling. Particulate matter and other compounds in the plant can be drawn into the scrubber and foul the pad.

Elements on which chrome sludge has accumulated require more intensive cleaning than normal washdown provides. An indication of this is when pressure drop exceeds that which existed on the clean unit by 1/2" w.g., or when visual inspection indicates that cleaning is necessary. Follow procedures outlined below.

Drain Traps

Since flow rate through the P-trap is usually very low, it may be necessary to disassemble and clean it to prevent its becoming plugged with sludge. The unit must be shut down before attempting to clean the trap. Since the trap will contain chromic acid deposits, care must be taken to prevent injury and to ensure proper disposal of the contents. Refill the trap with water when placing it back in service.

Exhaust Fans

Periodically check for excessive vibrations and excessive bearing temperature. Periodic lubrication of bearings is required. Inspect drive belts for proper tension and for wear. Maintenance instructions are included elsewhere in this manual.

CLEANING MIST ELIMINATORS

Mist eliminators are manufactured with a variety of media elements. Random-dumped packing, and mesh pads are both used.

Normal washdown procedure is as follows for three stage Hexmaster unit:

A. Take static pressure readings across all three differential gauges at initial start-up to determine drop across each stage when clean. Record reading by each differential gauge.

B. Stage one (1), two (2) and three (3) to be washed down when static pressure reading is 1/2" above clean reading. Wash down for 1 to 2 minutes. * Fan can remain running during washdown of stage one (1) and two (2). Immediately after washdown, static pressure will actually increase due to some of the washdown water remaining in the eliminator. Take reading of the differential gauge one (1) hour after washdown to get a true reading. Reading should be close to that of the clean reading.

* Fan must be turned off while washing stage three. Allow minimum period of one (1) hour to pass before starting up the fan to insure that the eliminator is totally drained.

If the normal washdown procedure does not adequately lower the pressure drop, the media elements must be removed in order to provide adequate washing and drying. The procedure for cleaning is as follows:

1. Turn fan off.

2. Prepare cleaning solution as outlined below. Temperature of this solution should not exceed 100°F.

3. Open access doors and remove the mist eliminator media, placing the elements into a cleaning tank.

4. Flood the tank with cleaning solution and let stand for 3 to 4 hours, although 8 to 10 hours is preferred for best efficiency. During this time, maintain concentration in the solution by adding chemical as needed. Agitation of the solution is helpful.

5. Mesh pads should be cleaned by soaking to ensure that all layers of the pad are exposed to the cleaning solution. Flexing the pad and/or alternately dipping and withdrawing it from the solution is effective in loosening scale.

   If plugging affects only the surface layers of a pad, it is possible to use high-pressure (up to 250 psig) and high-volume washing to mechanically remove material. Wash only from the front side of the pad.

6. When the elements are clean, drain the tank and refill with fresh water in order to rinse the material. Repeat with fresh water.

7. Drain the tank and allow the media elements to drain completely. The mist eliminator must be dry before it is placed back into service.

8. Proceed with normal start-up of the unit.

9. Check the outlet stack. Some misting may occur for a short period of time. If it lasts for more than fifteen or twenty minutes, turn the unit off and contact the factory.

If this washdown procedure does not adequately lower the pressure drop, the media elements must be removed in order to provide adequate washing and drying. Duall Division recommends purchasing a spare pad/cartridge assembly to eliminate down time associated with pad removal to clean.

The procedure for cleaning is as follows:

1. Turn fan and pump motors off. Drain liquid from the vessel sump area.

2. Open access doors and remove the mist eliminator media. This will require removing the mesh pad from the PVC cartridge if your unit is not equipped with an "easy open" cartridge. Unless you have an "easy open" cartridge, do not proceed unless an experienced PVC welder is available.

3. If plugging affects only the surface layers of the pad, it is possible to use high-pressure (up to 250 psig) and high-volume washing to mechanically remove material. Wash only from the front side of the pad.

   Particulate material that is not soluble in water or cleaning solution must be removed from the mesh pad by mechanical means. This usually means hitting the pad with high-pressure (up to 250 psig) water from a hose.

4. Since a directed stream of liquid will not penetrate a composite pad to any great extent, it may be necessary to separate the layers and to treat each layer individually. The layers are tied together and to a support grid at a number of places. The stitches must be cut in order to separate layers of the pad. To facilitate re-installation, do not cut the stitches along any one edge of the pad. They layers can then be opened like the leaves of a book to allow cleaning.

   During handling, care must be taken to avoid damage to exposed edges of the pad. Loss of fibers may necessitate having to repair the pad.

   After cleaning, the pad should be tied to the support grid on 6 inch centers. Use monofilament Kynar thread and a long plastic needle supplied with the pad. Duall can supply these. Make knots in accordance with the attached sketches.

   Do not compress the pad when it is being tied. This could result in higher localized pressure drop with subsequent flooding or mal-distribution of air.

5. When the elements are clean, allow the mesh pad to drain for a minimum of 8 hours.

6. Place the mesh pad cartridge in the vessel. The unit is ready for normal start-up.

7. Check the outlet stack while the unit is in operation. Some misting may occur for a short period of time. If it lasts for more than fifteen or twenty minutes, turn unit off and contact the factory.

PREPARATION OF CLEANING SOLUTIONS

Prepare a volume of cleaning solution to fill the recycle tank or a cleaning tank to its normal liquid level. The temperature of this solution should not exceed 100°F.

Dilute acid will remove scale or sludge caused by elements that form insoluble carbonates, sulfates, or hydroxides. Where cyanides or sulfides may be present, be sure that dissolution of the scale will not cause hydrogen cyanide or hydrogen sulfide to be released.

A 2% solution of sulfamic acid (HSO_3NH_2) in water is prepared by dissolving 18 pounds of dry sulfamic acid per 100 gallons of solution.

Hydrochloric (muriatic) acid is prepared by adding 2 gallons of 30% acid per 100 gallons of solution that is required.

A chlorine solution will remove deposits caused by growth of microorganisms (slime). Chlorine gas may be released if the pH of this solution is not kept above 8-9 units.

A 2% solution of hypochlorite is prepared by adding 13 gallons of 15% commercial solution per 100 gallons of water.

Other cases than those mentioned above will require individual analysis. It will be necessary to select a cleaning agent that is compatible with the materials of construction, that is effective for the particular foulant, and that is safe to use.

The chemicals being added to the cleaning solution may (especially in their concentrated form) irritate or burn skin, eyes, and mucous membranes, and may stain or destroy clothing. A Material Safety Data Sheet (MSDS) for each chemical should be obtained from your supplier. Observe recommended handling practices. In general:

- Wear safety glasses or goggles, gloves, and protective clothing when working with the chemicals or equipment which contains or transports them.

- Do not add water to concentrated chemical solutions. Dilution is accomplished by adding the chemical to water. Since a great deal of heat may be released by this action, take care to control the rate of addition to allow the heat to dissipate.

- Do not add acids to solutions of hypochlorite. Chlorine vapors may be released. Use caustic to maintain solution pH.

- Do not mix strong acids with strong alkali. Heat of reaction could cause the solution to boil.

- Do not mix strong oxidizing agents with organic chemicals. Explosive reactions may result.

- When disposing of chemicals, treat them as hazardous wastes.

TROUBLESHOOTING

This guide should help you to resolve problems which operators may have if various parts of the system fail or are not maintained. Problems with auxiliary equipment should be resolved by consulting manuals for the particular component.

1. Low Removal Efficiency

   If the scrubber is not removing contaminants in accordance with the design basis, you should check for:

   a. By-passing - look for tears in the mesh pads or signs of bleeding through. Repair as necessary.

   b. Particulate too small - take steps to encourage droplet growth and decrease droplet attrition, or replace pad with one having greater removal efficiency for smaller droplets.

2. Sludge Accumulation

   Sludge accumulation is to be expected. Periodic cleaning is necessary to prevent its becoming excessive. Sludge accumulation may be excessive because:

   a. Insufficient washdown frequency - clean affected items and increase cleaning frequency to prevent excessive accumulation of sludge.

   b. Insufficient liquid flow rate - clean affected items and check that the water source can deliver adequate pressure and volume.

3. Low Air Flow Rate

   If the air flow rate deviates from design flow by more than 5 percent, you should check for:

a. Fan speed too low - due to loose belt, wrong size drive sheaves, motor faults. Correct drive problem.

b. System pressure too high - due to obstruction such as closed damper, fouled packing or pads, or foreign object in air pathway. System changes such as additional duct or equipment can increase static pressure losses. Remove obstruction or change fan to accept higher load.

4. High Differential Pressure/Flooding

Excessive pressure loss through the packing or flooding of the packing with liquid are indicative of problems that must be corrected. You should check for:

a. Fouled packing or pads - due to accumulation of scale, sludge, or other material on the packing. Requires chemical or mechanical cleaning.

b. High air flow rate - due to improper sizing or control of the exhaust fan. Adjust to design rate.

TECHNICAL SUPPORT

In case of problems or questions concerning operation of this equipment, contact us at:

Met-Pro Corporation
Duall Division
1550 Industrial Drive
Owosso, Michigan 48867
517-725-8184 / fax 517-725-8188

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HEXMASTER OPERATING LOG

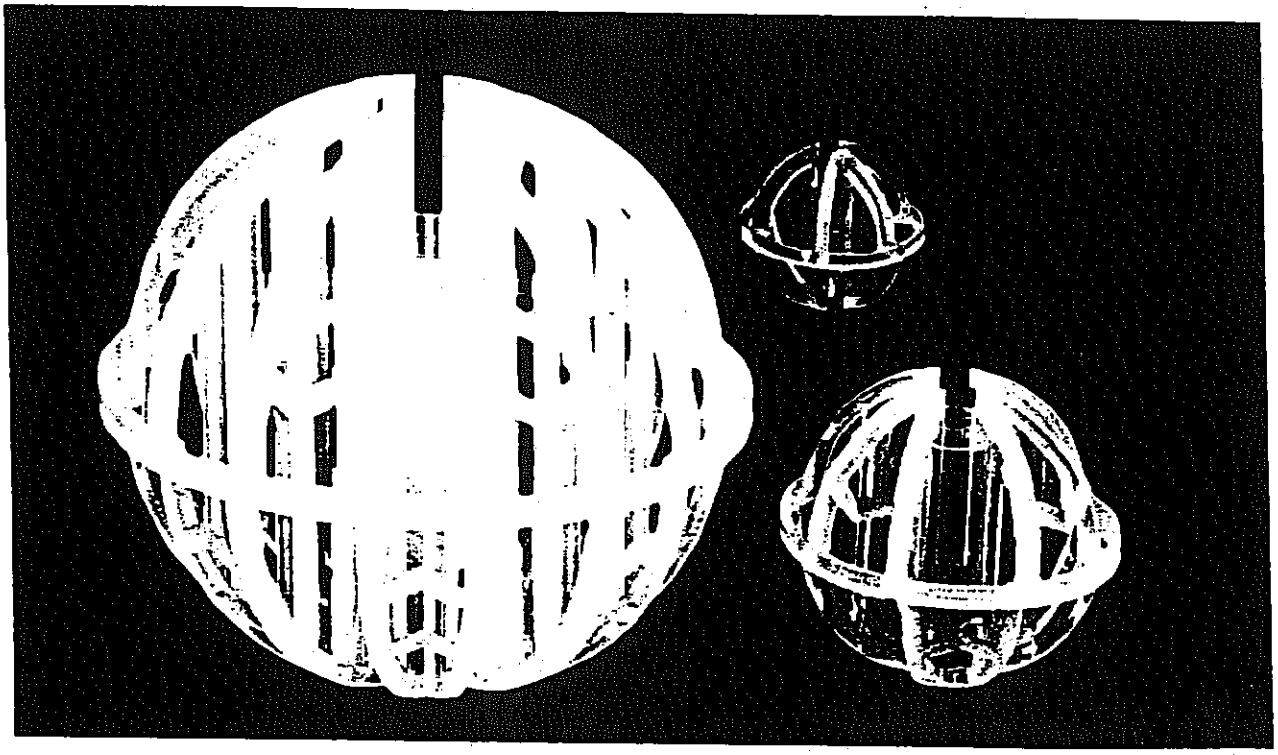
Date	Time	Wash Down Rate	* Pressure Drop			Air Flow Rate	Comments	Initials
			Stage #1	Stage #2	Stage #3			

* The total pressure drop across the unit must be within plus or minus 1" w.c. from that recorded during the performance test to be in compliance with federal regulations.

1ST & 3RD STAGE
ELIMINATOR

PLASTIC JAEGER TRI-PACKS®

High performance column packing



FEATURES

Plastic Jaeger Tri-Packs® is a hollow, spherical-shaped packing made of injection molded plastic in three sizes: 1", 2" and 3½" diameter. Its symmetrical geometry made from a unique network of ribs, struts and drip rods yields unprecedented performance. It has high void space, greater than packings of comparable size, and achieves superior pressure drop values, up to 90% reduction, as compared to other products. The packing has a high ACTIVE surface area, exposing all of its surface area to be fully wetted during column operation. The performance capabilities of plastic Jaeger Tri-Packs® have resulted in significant savings in hundreds of

BENEFITS

- Highest mass and/or heat transfer rate
- Extremely low pressure drop
- Free of plugging, fouling, nesting and wall channeling
- Highest flooding point and lowest wetting point
- Even gas and liquid distribution
- No interlocking or meshing
- Used as a mist eliminator

PLASTIC JAEGER TRI-PACKS®

SPECIFICATIONS

Materials. Nine standard, injection moldable plastics are available:

- Polypropylene (PP)
- Polyethylene (PE)
- Polypropylene Glass-Filled (PP-G)
- Noryl® (PPO)
- Kynar® (PVDF)
- Halar® (ECTFE)
- TopEx (LCP)
- Tefzel® (ETFE)
- Teflon® (PFA)

Others are available on request.

Sizes. Plastic Jaeger Tri-Packs® packings are made in three sizes:

No. ½...	1" Nominal
No. ½ A...	1¼" Nominal
No. 1...	2" Nominal
No. 2...	3½" Nominal

PHYSICAL PROPERTIES

Size (in.)	1	1¼	2	3½
Geometric Surface Area (ft^2/ft^3)	85	70	48	38
Packing Factor (1/ft)	28	25	16	12
Void Space (%)	90	92	93	95
Weight (lb/ft^3)	6.2	5.6	4.2	3.3

MASS TRANSFER DATA

Absorption System	G ($lb/hr\text{-}ft^2$)	L ($lb/hr\text{-}ft^2$)	Temp. (°F)	HTU - Inches 2" & 3½"	HTU - Inches 1"
$HCl\text{-}H_2O$	1792	2048	77	10.6	7.0
HCl-NaOH	1567	2048	68	8.8	6.1
Cl_2-NaOH	1229	2202	122	14.5	9.9
$NO_2\text{-}Na_2S$+NaOH	717	1127	68	49.2	32.0
$NH_3\text{-}H_2SO_4$	492	1024	68	6.0	4.1
$NH_3\text{-}H_2O$	512	1024	68	8.4	5.6
$NH_3\text{-}H_2O$	512	4096	68	5.4	3.6
SO_2-NaOH	1946	4096	140	12.0	8.1
$HF\text{-}H_2O$	1844	3072	77	6.9	4.6
$CH_3COCH_3\text{-}H_2O$	1700	860	68	15.2	10.2
H_2S-NaOH	1229	1331	68	19.4	13.0

VOC Stripping	G ($lb/hr\text{-}ft^2$)	L ($lb/hr\text{-}ft^2$)	Temp. (°F)	HTU - Inches 2"	HTU - Inches 1"
TCE(ppm)-H_2O	479	12264	77	26.9	21.5
TCE(ppm/ppb)-H_2O	690	12494	60	37.6	30.1
BTX(ppb)-H_2O	722	4998	70	39.2	31.4

Superior performance by design

JAEGER PRODUCTS, INC.

JAEGER PRODUCTS, INC.
1611 Peach Leaf
Houston, Texas 77039
(713) 449-9500 Fax: (713) 449-9400
Toll Free 800-678-0345

TF

22 GPM @ 17.76 PSI

Wide Range of Flows and Angles

60°, 90°, 120° Metal

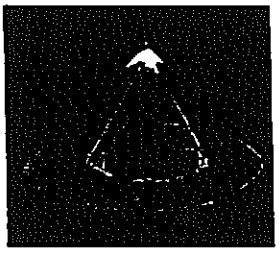
DESIGN FEATURES

- The original spiral nozzle
- High energy efficiency
- One piece/no internal parts
- Clog-resistant performance
- High discharge velocity
- Male connection standard; female connection available by special order

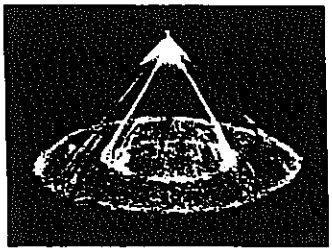
SPRAY CHARACTERISTICS

- Wide range of flow rates and spray angles
- Fine atomization

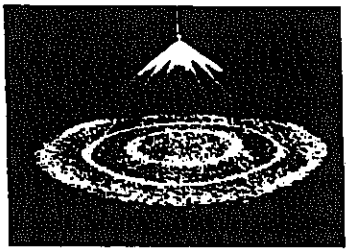
Spray patterns: Full and Hollow Cone
Spray angles: 50° to 180°
Flow rates: .7 to 3320 gpm
(Higher flow rates available)



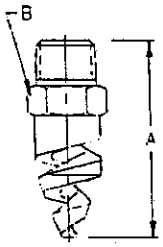
Full Cone 60° (NN)



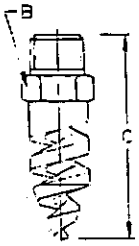
Full Cone 90° (FCN)



Full Cone 150°/170°



60 . 90 . 120



150 . 170

TF Full Cone Flow Rates and Dimensions

Full Cone, 60° (NN), 90° (FCN or FFCN), 120° (FC or FFC), 150° and 170° Spray Angles. 1/8" to 4" Pipe Sizes

Male Pipe Size	Nozzle Number	Available Spray Angles	K Factor	GALLONS PER MINUTE @ PSI: 5 PSI	10 PSI	20 PSI	30 PSI	40 PSI	50 PSI	60 PSI	80 PSI	100 PSI	200 PSI	400 PSI	Approx. (in.) Orif. Dia.	Approx. (in.) Free Pass. Dia.	Dim. (in.) for Metal Only* A	B	C	Wt. (oz.) 60 90 120 Metal	Plas.
1/8	TF8	60° 90° 120°	0.221		0.70	0.99	1.21	1.40	1.57	1.71	1.98	2.21	3.13	4.43	0.09	0.09	1.69	0.56		1.00	0.20
	TF8	60 90 120°	0.411		1.30	1.84	2.25	2.60	2.91	3.18	3.68	4.11	5.81	8.22	0.13	0.13					
1/4	TF6	60 90 120	0.221		0.70	0.99	1.21	1.40	1.57	1.71	1.98	2.21	3.13	4.43	0.09	0.09					
	TF8	60 90 120	0.411		1.30	1.84	2.25	2.60	2.91	3.18	3.68	4.11	5.81	8.22	0.13	0.13	1.88	0.56		1.25	0.20
	TF10	60 90 120	0.632		2.00	2.83	3.46	4.00	4.47	4.90	5.66	6.32	8.94	12.6	0.16	0.13					
3/8	TF6	60°	0.221		0.70	0.99	1.21	1.40	1.57	1.71	1.98	2.21	3.13	4.43	0.09	0.09					
	TF8	60°	0.411		1.30	1.84	2.25	2.60	2.91	3.18	3.68	4.11	5.81	8.22	0.13	0.13					
	TF10	60°	0.632		2.00	2.83	3.46	4.00	4.47	4.90	5.66	6.32	8.94	12.6	0.16	0.13					
	TF12	60° 90° 120° 150° 170°	0.949		3.00	4.24	5.20	6.00	6.71	7.35	8.49	9.49	13.4	19.0	0.19	0.13	1.88	0.69	2.38	1.63	0.25
	TF14	60° 90° 120° 150° 170°	1.28		4.05	5.73	7.01	8.10	9.06	9.92	11.5	12.8	18.1	25.6	0.22	0.13					
	TF16	60° 90° 120° 150° 170°	1.68		5.30	7.50	9.18	10.6	11.9	13.0	15.0	16.8	23.7	33.5	0.25	0.13					
	TF20	60° 90° 120° 150° 170°	2.61		8.25	11.7	14.3	16.5	18.4	20.2	23.3	26.1	36.9	52.2	0.31	0.13					
1/2	TF24	60 90 120 150 170	3.81	8.52	12.1	17.0	20.9	24.1	26.9	29.5	34.1	38.1	53.9	76.2	0.38	0.19					
	TF28	60 90 120 150 170	5.22	11.7	16.5	23.3	28.6	33.0	36.9	40.4	45.7	52.2	73.8	104	0.44	0.19	2.50	0.88	3.06	3.00	0.50
3/4	TF32	60° 90° 120° 150° 170°	6.64	14.8	21.0	29.7	36.4	42.0	47.0	51.4	59.4	66.4	93.9	133	0.50	0.19	2.75	1.13	3.50	5.50	0.88
1	TF40	60 90 120 150 170	10.6	23.7	33.5	47.4	58.0	67.0	74.9	82.1	94.9	106	150	212	0.63	0.25					
	TF48	60 90 120 150 170	15.0	33.6	47.5	67.2	82.3	95.0	106	116	134	150	212	300	0.75	0.25	3.63	1.38	4.38	8.50	2.50
1 1/2	TF56	60° 90° 120° 150° 170°	20.4	45.6	64.5	91.2	112	129	144	158	182	204	288	408	0.88	0.31			5.38		
	TF64	60° 90° 120° 150° 170°	26.7	59.7	84.5	120	146	169	189	207	239	267	378	534	1.00	0.31	4.38	2.00	5.38	22.0	4.25
	TF72	60° 90° 120° 150° 170°	30.4	67.9	96.0	136	166	192	215	235	272	304	429	607	1.13	0.31			5.63		
2	TF88	90 120 150 170	44.3	99.0	140	198	242	280	313	343	396	443	625	885	1.38	0.44	5.63	2.50	6.88	46.0	8.00
	TF96'	90 120 150 170	55.9	125	177	250	306	354	395	433	500	559	791	1120	1.50	0.44	6.88	2.50	7.00	54.0	9.00
3	TF112'	90° 120°	81.0	181	256	362	443	512	572	627	724	810	1150	1620	1.75	0.56	8.63	3.50		114	20.0
	TF128'	90° 120°	107	239	339	480	588	679	759	831	960	1070	1510	2150	2.00	0.56					
4	TF160'	90 120	166	371	525	742	909	1050	1170	1290	1480	1660	2350	3320	2.50	0.63	10.1	4.50		169	27.0

High PSI operation recom. for Metal Only

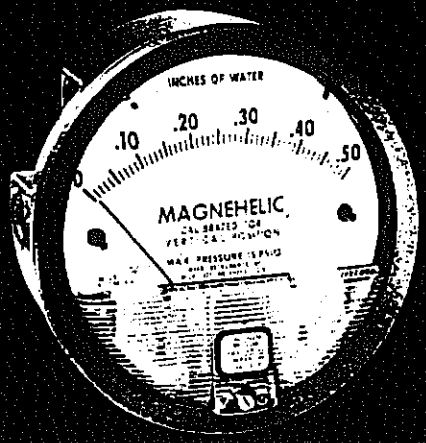
Flow Rate (GPM) = K . PSI *Dimensions are for bar stock, cast sizes may vary. Three turn nozzles

Standard Materials: Brass, 316 Stainless Steel, PVC, Polypropylene and Teflon® (Poly. not available for TF6 &TF8). See chart on page 17 for complete list

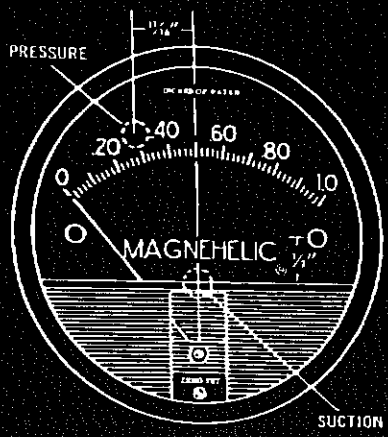
TO ORD... ...ecify pipe size, connection type, ...r, spray angle, and material.

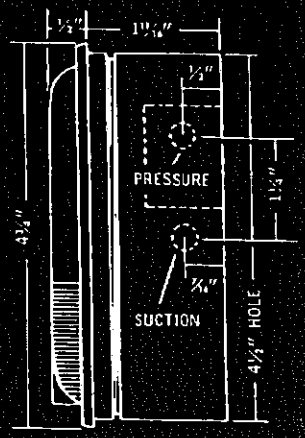
Dwyer

SERIES 2000 Magnehelic® Differential Pressure Gages



Standard Magnehelic® Pressure Gage has a large, easy-to-read 4" dial.





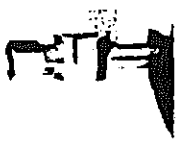
Dimensions, Standard Series 2000 Magnehelic® Pressure Gages. (Slightly different on medium and high pressure models)

Select the Dwyer Magnehelic® gage for high accuracy – guaranteed within 2% of full scale – and for the wide choice of 81 ranges available to suit your needs precisely. Using Dwyer's simple, frictionless Magnehelic® movement, it quickly indicates low air or non-corrosive gas pressures – either positive, negative (vacuum) or differential. The design resists shock, vibration and over-pressures. No manometer fluid to evaporate, freeze or cause toxic or leveling problems. It's inexpensive, too.

Widely used to measure fan and blower pressures, filter resistance, air velocity, furnace draft, pressure drop across orifice plates, liquid levels with bubbler systems and pressures in fluid amplifier or fluidic systems. It also checks gas-air ratio controls and automatic valves, and monitors blood and respiratory pressures in medical care equipment.

Flush...Surface...or Pipe Mounted

Mounting. A single case size is used for most ranges of Magnehelic gages. They can be flush or surface mounted with standard hardware supplied. With the optional A-610 Pipe Mounting Kit they may be conveniently installed on horizontal or vertical 1¼"-2" pipe. Although calibrated for vertical position, many ranges above 1 inch may be used at any angle by simply re-zeroing. However, for maximum accuracy, they must be calibrated in the same position in which they are used. These characteristics make Magnehelic gages ideal for both stationary and portable applications. A 4½" hole is required for flush panel mounting. Complete mounting and connection fittings plus instructions are furnished with each instrument.



Vent valves

In applications where pressure is continuous and the Magnehelic gage is connected by metal or plastic tubing which cannot be easily removed, we suggest using Dwyer A-310A vent valves to connect gage. Pressure can then be removed to check or re-zero the gage.

HIGH AND MEDIUM PRESSURE MODELS

Installation is similar to standard gages except that a 4¼" hole is needed for flush mounting. The medium pressure construction is rated for internal pressures up to 35 psig and the high pressure up to 80 psig. Available in all ranges. Because of larger case, will not fit in portable case. Weight 1 lb., 10 oz. (Installation of the A-321 safety relief valve on standard Magnehelic gages often provides adequate protection against infrequent overpressure; see Bulletin S-101).

1ST, 3ED, ! HEPA 2002

PHYSICAL DATA

Ambient temperature range: 20° to 140°F.*

Rated total pressure: –20" Hg. to 15 psig.†

Connections: ⅛" NPT high and low pressure taps, duplicated – one pair side and one pair on back.

Housing: Die cast aluminum. Case and aluminum parts Iridite-dipped to withstand 168 hour salt spray test. Exterior finish is baked dark gray hammerloid.

Standard ranges: See facing page.

Accuracy: Plus or minus 2% of full scale (3% on –0 and 4% on –00 ranges), throughout range at 70°F.

Standard accessories: Two ⅛" NPT plugs for duplicate pressure taps, two ⅛" pipe thread to rubber tubing adapters, and three flush mounting adapters with screws. (Mounting ring and snap ring retainer substituted for 3 adapters in MP & HP gage accessories.)

Weight: 1 lb. 2 oz.

*Low temperature models available as special option.
†For applications with high cycle rate within gage total pressure rating, next higher rating is recommended. See Medium and High pressure options at lower left.

OPTIONS AND ACCESSORIES

Transparent overlays
Furnished in red and green to highlight and emphasize critical pressures.

Adjustable signal flag
Integral with plastic gage cover; has external reset screw. Available for all ranges (not high pressure). Can be ordered with gage or separately.

Portable units
Combine carrying case with any Magnehelic gage of standard range (not high pressure). Includes 9 ft. of ¼" I.D. rubber tubing, stand-hang bracket, and terminal tube with holder.

Air filter gage accessory package
Adapts any standard Magnehelic for use as an air filter gage. Includes aluminum surface-mounting bracket with screws, two 5 ft. lengths of ¼" aluminum tubing, two static pressure tips and two molded plastic vent valves, integral compression fittings on both tips and valves.

Quality design and construction features

Bezel provides flange for flush mounting in panel.

Clear plastic face is highly resistant to breakage. Provides undistorted viewing of pointer and scale.

Precision litho-printed scale is accurate and easy to read.

Red tipped pointer of heat treated aluminum tubing is easy to see. It is rigidly mounted on helix shaft.

Pointer stops of molded rubber prevent pointer over-travel without damage.

Sapphire bearings are shock-resistant mounted; provide virtually friction-free motion for helix. Motion damped with high viscosity silicone fluid.

Zero adjustment screw is conveniently located in plastic cover, accessible without removing cover. "O" ring seal provides pressure tightness.

"O" ring seal for cover assures pressure integrity of case.

Die cast aluminum case is precision made. Iridite-dipped to withstand 168 hour salt spray test. Exterior finished in baked dark gray hammerloid. One case size used for all standard pressure ranges, and for both surface and flush mounting.

Silicone rubber diaphragm with integrally molded "O" ring is supported by front and rear plates. It is locked and sealed in position with a sealing plate and retaining ring. Diaphragm motion is restricted to prevent damage due to overpressures.

Calibrated range spring is a flat leaf of Swedish spring steel in temperature compensated design. Small amplitude of motion assures consistency and long life. It reacts to pressure on diaphragm. Live length adjustable for calibration.

"Wishbone" assembly provides mounting for helix, helix bearings and pointer shaft.

Samarium cobalt magnet mounted at end of range spring rotates helix without mechanical linkages.

Helix is precision milled from an alloy of high magnetic permeability, deburred and annealed in a hydrogen atmosphere for best magnetic qualities. Mounted in jeweled bearings, it turns freely to align with magnetic field of magnet to transmit pressure indication to pointer.

SERIES 2000 MAGNEHELIC® — MODELS AND RANGES

The models below will fulfill most requirements. Page 5 also shows examples of special models built for OEM customers. For special scales furnished in ounces per square inch, inches of mercury, metric units, etc., contact the factory.

Model Number	Range, Inches of Water	Minor Div.
2000-00††	0-.25	.005
2000-0††	0-.50	.01
2001	0-1.0	.02
2002	0-2.0	.05
2003	0-3.0	.10
2004	0-4.0	.10
2005	0-5.0	.10
2006	0-6.0	.20
2008	0-8.0	.20
2010	0-10	.20
2015	0-15	.50
2020	0-20	.50
2025	0-25	.50
2030	0-30	1.0
2040	0-40	1.0
2050	0-50	1.0
2060	0-60	2.0
2080	0-80	2.0
2100	0-100	2.0
2150	0-150	5.0

Model Number	Range, Zero Center, Inches of Water	Minor Div.
2300-0††	±.25	.01
2301††	±.5	.02
2302††	±1.0	.05
2304	±2.0	.10
2310	±5.0	.20
2320	±10	.50
2330	±15	1.0

Model Number	Range, PSI	Minor Div.
2201*	0-1	.02
2202*	0-2	.05
2203*	0-3	.10
2204*	0-4	.10
2205*	0-5	.10
2210**	0-10	.20
2215**	0-15	.50
2220**	0-20	.50
2230**	0-30	1.0

*MP option standard
**HP option standard

Model Number	Range, Inches of Water	Range, Air Velocity F.P.M.
2000-00AV†	0-.25	300-2000
2000-0AV†	0-.50	500-2800
2001AV	0-1.0	500-4000
2002AV	0-2.0	1000-5600
2010AV	0-10	2000-12500

†For use with pitot tube

Model Number	Range, MM of Water	Minor Div.
2000-6MM†	0-6	.20
2000-10MM†	0-10	.20
2000-25MM	0-25	.50
2000-50MM	0-50	1.0
2000-80MM	0-80	2.0
2000-100MM	0-100	2.0

Zero Center Range

2300-20MM†	10-0-10	.50

Model Number	Range, CM of Water	Minor Div.
2000-15CM	0-15	.50
2000-20CM	0-20	.50
2000-25CM	0-25	.50
2000-50CM	0-50	1.0
2000-80CM	0-80	2.0
2000-100CM	0-100	2.0
2000-150CM	0-150	5.0
2000-200CM	0-200	5.0
2000-250CM	0-250	5.0
2000-300CM	0-300	10.0

Zero Center Ranges

2300-4CM	±2.0	.10
2300-10CM	±5.0	.20
2300-30CM	±15.0	1.0

†These ranges calibrated for vertical scale position.

Model Number	Range, Pascals	Minor Div.
2000-60 Pa†	0-60	2.0
2000-125 Pa†	0-125	5.0
2000-250 Pa	0-250	5.0
2000-500 Pa	0-500	10.0
2000-750 Pa	0-750	25.0

Zero Center Ranges

2300-250 Pa	±125-0-125	5.0
2300-500 Pa	±250-0-250	10.0

Model Number	Range, Kilopascals	Minor Div.
2000-1 kPa	0-1	.02
2000-1.5 kPa	0-1.5	.05
2000-2 kPa	0-2	.05
2000-3 kPa	0-3	.10
2000-4 kPa	0-4	.10
2000-5 kPa	0-5	.10
2000-8 kPa	0-8	.20
2000-10 kPa	0-10	.20
2000-15 kPa	0-15	.50
2000-20 kPa	0-20	.50
2000-25 kPa	0-25	.50
2000-30 kPa	0-30	1.0

Zero Center Ranges

2300-1 kPa	±.5-0-.5	.02
2300-3 kPa	±1.5-0-1.5	.10

Suggested Specifications

A differential pressure gage for measuring (state purpose) shall be installed. Gage shall be the diaphragm-actuated dial type, 3¾" O.D., with white dial, black figures and graduations and pointer zero adjustment. Gage shall be Dwyer Instruments, Inc., Magnehelic®, Catalog No. _____, reading to _____" water column, in _____ divisions.

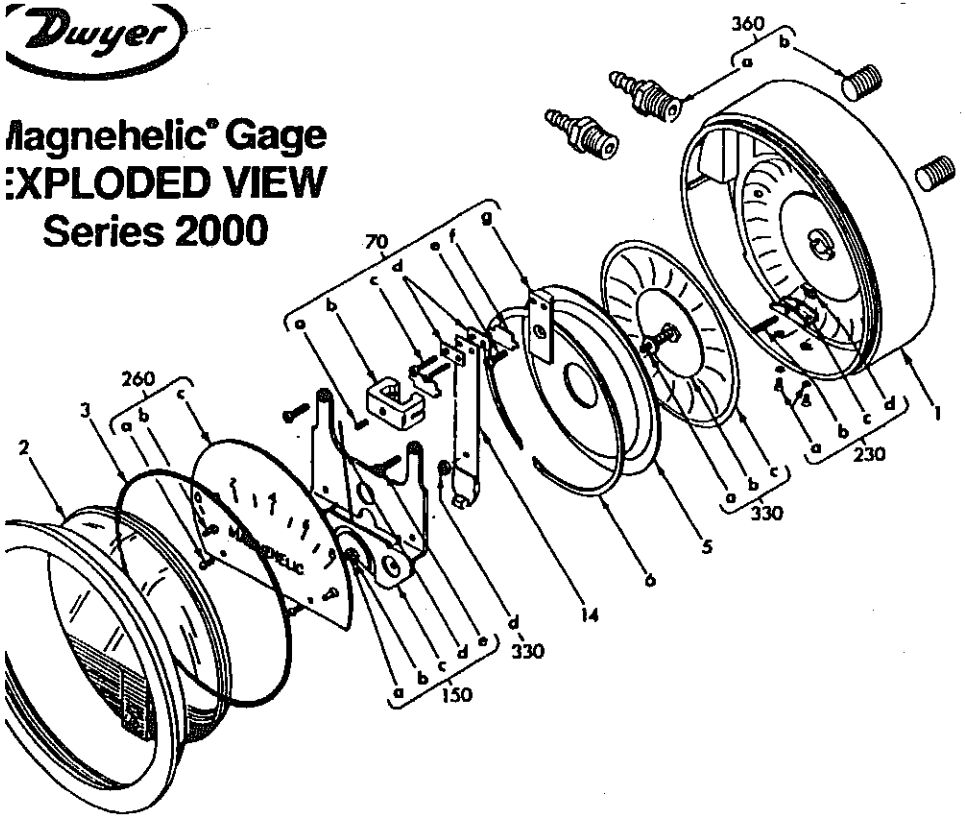
Special Purpose Ranges

Scale No. 2401 Square Root Specify Range

Scale No. 2402 Blank Scale Specify Range

Model 2000-00N, Range = .05 to +.20" W.C. For room pressure monitoring.

Magnehelic® Gage EXPLODED VIEW Series 2000



1. Case
2. Cover with zero adjust assy.
3. "O" ring seal
4. Bezel
5. Diaphragm sealing plate
6. Retaining ring
70. Range Spring assembly
    a. Clamp set screw
    b. Clamp
    c. Mounting screws (2 req'd)
    d. Clamping shoe (2 req'd)
    e. Clamp plate screw
    f. Spacer (2 req'd)
    g. Clamp plate
14. Range Spring with magnet
150. Wishbone Assembly – consists of:
    a. Front jewel
    b. Locking nut
    c. Wishbone
    d. Pointer
    e. Mounting screws (2 req'd)
    f. Helix assembly (not shown)
    g. Pivots (2 req'd) (not shown)
    h. Rear jewel (not shown)
230. Zero adjust assembly – consists of:
    a. Foot screws with washers (2 req'd)
    b. Adjust screw
    c. Foot
    d. Finger
260. Scale Assembly – consists of:
    a. Mounting screws (2 req'd)
    b. Bumper pointer stop (2 req'd)
    c. Scale
330. Diaphragm Assembly – consists of: (Arbor press needed to install)
    a. Linkage assy., complete
    b. Front plate
    c. Diaphragm
    d. Rear plate (not shown)
    e. Plate washer (not shown)
360. Mounting Hardware Kit
    a. Adapter – pipe plug ⅛" NPT to rubber tubing – (2 req'd)
    b. Pipe plug ⅛" NPT – (2 req'd)
    c. Mounting lug (3 req'd)
    d. Long screw (3 req'd)
    e. Short screw (3 req'd)

Ordering Instructions:

When corresponding with the factory regarding Magnehelic® gage problems, refer to the call-out numbers in this view. Be sure to include model number, pressure range, and any special options. Field repair is not recommended; contact the factory for repair service information.

Printed in U.S.A. 6/03

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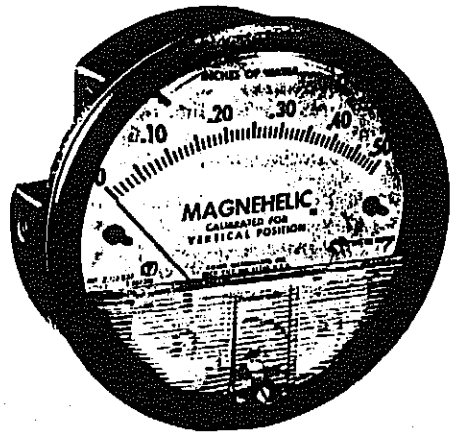
OPERATING INSTRUCTIONS ... PART ...

Magnehelic® Differential Pressure Gage



SPECIFICATIONS

Dimensions: 4-3/4" dia. X 2-3/16" deep.

Weight: 1 lb. 2 oz.

Finish: Baked dark gray enamel.

Connections: 1/8 N.P.T. high and low pressure taps, duplicated, one pair side and one pair back.

Accuracy: Plus or minus 2% of full scale, at 70°F. (Model 2000-0, 3%; 2000-00, 4%).

Pressure Rating: 15 PSI.

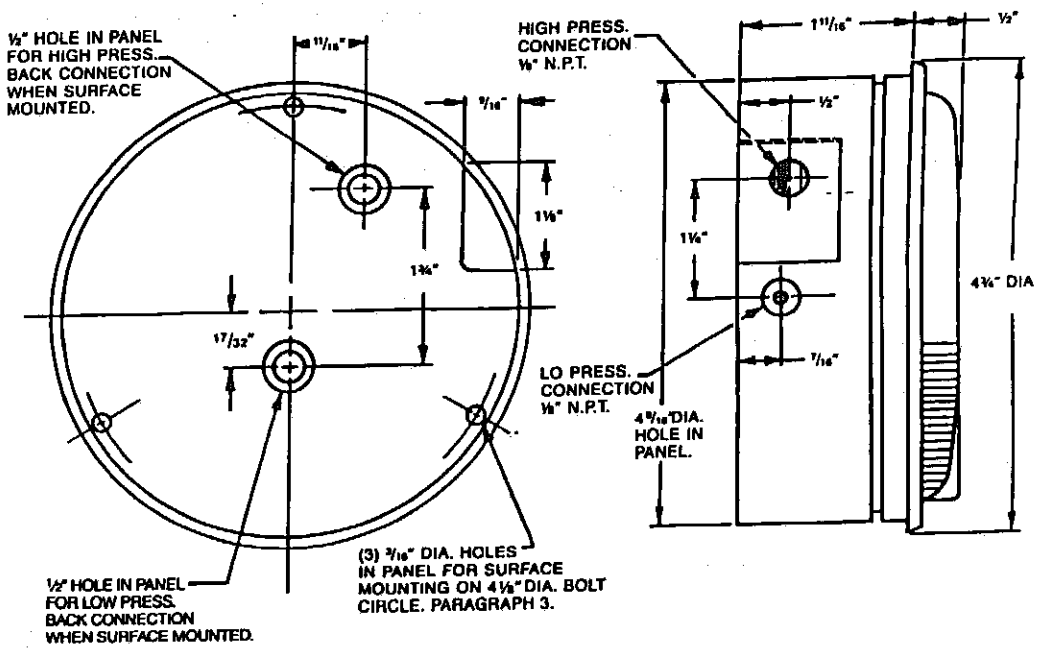
Ambient Temperature Range: 20° to 140°F.

Standard gage accessories include two 1/8" N.P.T. plugs for duplicate pressure taps, two 1/8" pipe thread to rubber tubing adapters, and three flush mounting adapters with screws.

Caution: For use with air or compatible gases only.

For repeated over-ranging or high cycle rates, contact factory.

Hydrogen Gas Precautionary Note: The rectangular rare earth magnet used in the standard gage may not be suitable for use with hydrogen gas since a toxic and explosive gas may form. For hydrogen service, consult the factory for an alternate gage construction.



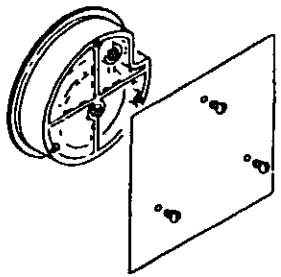
DWYER INSTRUMENTS, INC.
P.O. BOX 373 • MICHIGAN CITY, INDIANA 46360, U.S.A.
Telephone 219/879-8000
Fax 219/872-9057

MAGNEHELIC INSTALLATION

1. Select a location free from excessive vibration and where the ambient temperature will not exceed 140°F. Also, avoid direct sunlight which accelerates discoloration of the clear plastic cover. Sensing lines may be run any necessary distance. Long tubing lengths will not affect accuracy but will increase response time slightly. Do not restrict lines. If pulsating pressures or vibration cause excessive pointer oscillation, consult the factory for ways to provide additional damping.

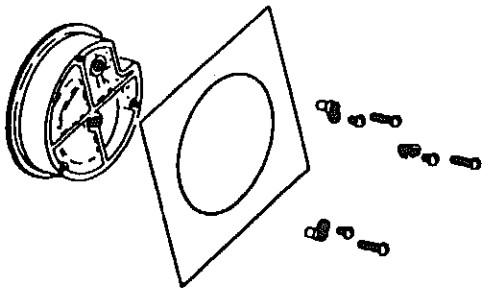
2. All standard Magnehelic gages are calibrated with the diaphragm vertical and should be used in that position for maximum accuracy. If gages are to be used in other than vertical position, this should be specified on the order. Many higher range gages will perform within tolerance in other positions with only rezeroing. Low range Model 2000-00 and metric equivalents must be used in the vertical position only.

3. Surface Mounting



Locate mounting holes, 120° apart on a 4-1/8" dia. circle. Use No. 6-32 machine screws of appropriate length.

4. Flush Mounting



Provide a 4⅛" dia. opening in panel. Insert gage and secure in place with No. 6-32 machine screws of appropriate length, with adaptors, Part No. 360c, firmly secured in place. To mount gage on 1¼"-2" pipe, order optional A-610 pipe mounting kit.

5. To zero the gage after installation

Set the indicating pointer exactly on the zero mark, using the external zero adjust screw on the cover at the bottom. Note that the zero check or adjustment can only be made with the high and low pressure taps both open to atmosphere.

Operation

Positive Pressure: Connect tubing from source of pressure to either of the two high pressure ports. Plug the port not used. Vent one or both low pressure ports to atmosphere.

Negative Pressure: Connect tubing from source of vacuum or negative pressure to either of the two low pressure ports. Plug the port not used. Vent one or both high pressure ports to atmosphere.

Differential Pressure: Connect tubing from the greater of two pressure sources to either high pressure port and the lower to either low pressure port. Plug both unused ports.

When one side of gage is vented in a dirty, dusty atmosphere, we suggest an A-331 Filter Vent Plug be installed in the open port to keep inside of gage clean.

a. For portable use or temporary installation, use 1/8" pipe thread to rubber tubing adapter and connect to source of pressure with rubber or Tygon tubing.

b. For permanent installation, 1/4" O.D., or larger, copper or aluminum tubing is recommended. See accessory bulletin S-101 for fittings.

Maintenance: No lubrication or periodic servicing is required. Keep case exterior and cover clean. Occasionally disconnect pressure lines to vent both sides of gage to atmosphere and re-zero. Optional vent valves, (bulletin S-101), should be used in permanent installations.

Calibration Check: Select a second gage or manometer of known accuracy and in an appropriate range. Using short lengths of rubber or vinyl tubing, connect the high pressure side of the Magnehelic gage and the test gage to two legs of a tee. Very slowly apply pressure through the third leg. Allow a few seconds for pressure to equalize, fluid to drain, etc., and compare readings. If accuracy unacceptable, gage may be returned to factory for recalibration. To calibrate in the field, use the following procedure.

Calibration:

1. With gage case, P/N 1, held firmly, loosen bezel, P/N 4 by turning counterclockwise. To avoid damage, a canvas strap wrench or similar tool should be used.
2. Lift out plastic cover and "O" ring.
3. Remove scale screws and scale assembly. Be careful not to damage pointer.
4. The calibration is changed by moving the clamp, P/N. 70-b. Loosen the clamp screw(s) and move slightly toward the helix if gage is reading high, and away if reading low. Tighten clamp screw and install scale assembly.
5. Place cover and O-ring in position. Make sure the hex shaft on inside of cover is properly engaged in zero adjust screw, P/N 230-b.
6. Secure cover in place by screwing bezel down snug. Note that the area under the cover is pressurized in operation and therefore gage will leak if not properly tightened.
7. Zero gage and compare to test instrument. Make further adjustments as necessary.

Caution: If bezel bi[illegible]vhen installing, lubricate threads spari[illegible], with light oil or molybdenum disulphide compound.

Warning: Attempted field repair may void your warranty. Recalibration or repair by the user is not recommended. For best results, return gage to the factory. Ship prepaid to:

Dwyer Instruments, Inc.
Attn. Repair Dept.
55 Ward St.
Wakarusa, IN 46573

Trouble Shooting Tips:

• *Gage won't indicate or is sluggish.*

1. Duplicate pressure port not plugged.
2. Diaphragm ruptured due to overpressure.
3. Fittings or sensing lines blocked, pinched, or leaking.
4. Cover loose or "O" ring damaged, missing.
5. Pressure sensors, (static tips, Pitot tube, etc.) improperly located.
6. Ambient temperature too low. For operation below 20°F, order gage with low temperature, (LT) option.

• *Pointer stuck-gage can't be zeroed.*

1. Scale touching pointer.
2. Spring/magnet assembly shifted and touching helix.
3. Metallic particles clinging to magnet and interfering with helix movement.
4. Cover zero adjust shaft broken or not properly engaged in P/N 230-b adjusting screw.

We generally recommend that gages needing repair be returned to the factory. Parts used in various sub-assemblies vary from one range of gage to another, and use of incorrect components may cause improper operation or failure. Gages repaired at the factory are carefully calibrated and tested to assure "like-new" operation. After receipt and inspection, we will be happy to quote repair costs before proceeding.

Consult factory for assistance on unusual applications or conditions.

Use with air or compatible gases only.

DWYER INSTRUMENTS, INC.
P.O. BOX 373 • MICHIGAN CITY, INDIANA 46360, U.S.A.
Telephone 219/879-8000
Fax 219/872-9057

BULLETIN 353H

BEARING FREE SEALLESS VERTICAL PUMPS

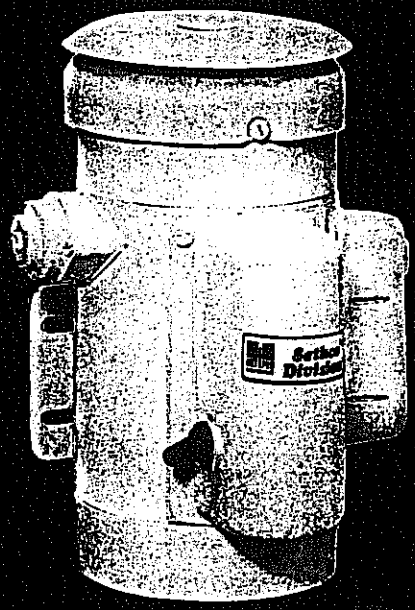
FOR CORROSIVE LIQUID APPLICATIONS

Supersedes Bulletin 353G

MET PRO CORPORATION **Sethco Division**

FEATURES:

- BEARING FREE AND SEALLESS.
- CORROSION AND ABRASION RESISTANT.
- CPVC TO 200°F (93°C) SERVICE (MOST MODELS). PVDF TO 280°F (137°C) SERVICE.
- MOST MODELS RECOMMENDED FOR ALL ELECTROLESS NICKEL AND COPPER SOLUTIONS.
- CONTINUOUS DUTY SERVICE.
- 10 MODELS TO 132 GPM (500 LPM) PRESSURES TO 53 PSI.
- COMPACT DESIGN - MOUNTS INSIDE OR OUTSIDE OF TANK.
- CAN RUN DRY WITHOUT PUMP DAMAGE.
- SELF-PRIMING WHEN IMMERSED.
- MAINTENANCE FREE - ONLY ONE MOVING PART.
- NO METAL CONTACT WITH SOLUTION.

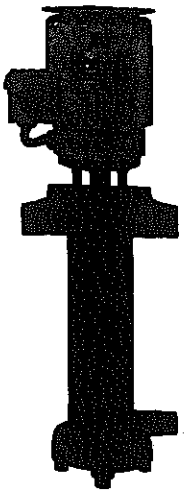


Designed with no seals, no bearings and no wearing parts. They can even run dry!

Sethco's "ZDX" series pumps are specially designed for in-tank or out-of-tank use. They're built for heavy duty pumping of acid and alkaline solutions (pH 0-14) and other corrosive liquids at temperatures as high as 280°F (137°C). Fully portable, these compact pumps can easily be transferred to different working areas as needed.

Patented, twin impeller design for high volume circulation and leakproof operation.

Sethco's "ZDX" series pumps incorporate a unique opposing twin-impeller design. This special patented feature provides high volume circulation and eliminates leakage up the pump column. No bearings or seals and no wearing parts in the pump permit dry running without damage. Rugged, corrosion resistant CPVC or Natural PVDF construction eliminates any metal contact preventing contamination or any reaction with corrosive liquids.

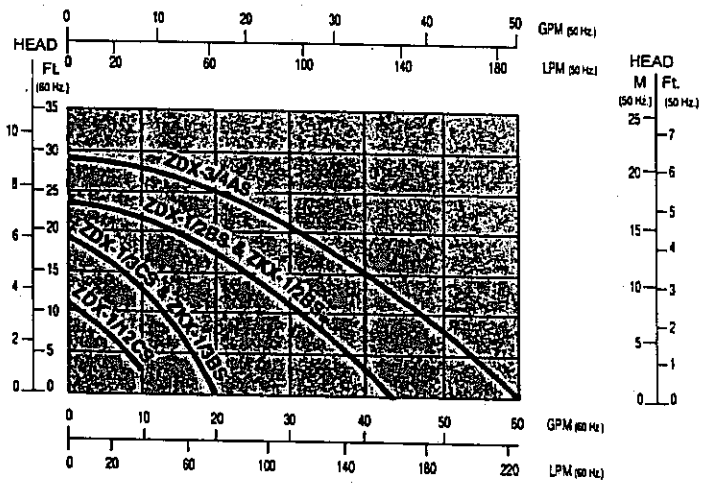


Design Features:

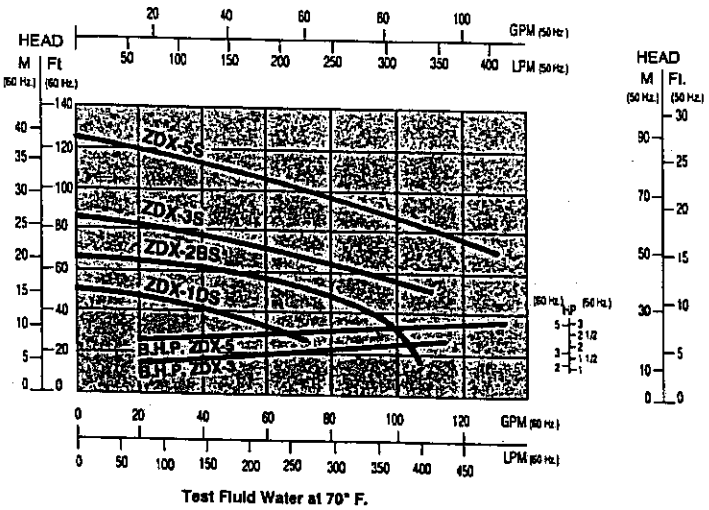
- Corrosion Resistant Drip Cover
- Motor Designed for Corrosion Resistance
- Heavy Duty Mounting Panel
- CPVC or Natural PVDF Sleeve Covers Motor Shaft
- Liquid Barrier - No Leakage Up Column
- High Flow Twin Impeller Design
- One Piece Extended Motor Shaft

CPVC CONSTRUCTION for acid and alkaline solutions, abrasive fluids and other corrosive liquids up to 200°F (137°C) . Maximum temperature for ZDX-3 and 5 is 165°F (74°C)

PVDF CONSTRUCTION: Natural PVDF for ultra pure applications, such as DI water and hydrofluoric acid. Maximum temperature is 210°F (99°C).



Test Fluid Water at 70° F.



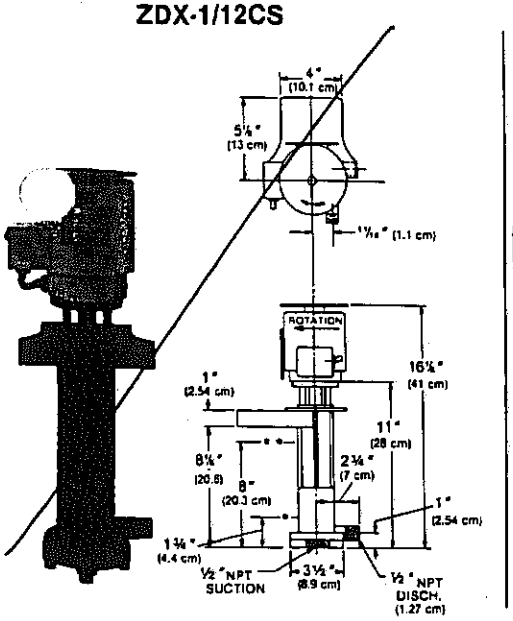
Test Fluid Water at 70° F.

PUMP SPECIFICATIONS: FLOW CAPACITIES TO 132 GPM, PRESSURE TO 123 FT. 10 CORROSION RESISTANT MODELS TO CHOOSE FROM.

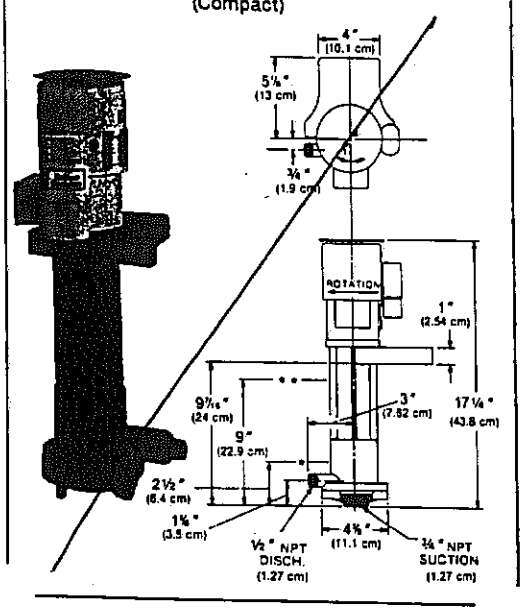
Model	Material of Construction	Max. Flow GPM	Max. Flow LPM	Max. Head Ft.	Max. Head M	Max. Oper. Temp.	Motor Characteristics HP	Volts	Hz	Phase	Type	Weight (lbs./Kg.) NET lbs.	NET Kg.	PACKED lbs.	PACKED Kg.
ZDX-1/12 CS	CPVC	10	38	10	3	200°F/ 93°C	1/20	115/230	50/60	1	TEFC	7	3.2	9	4.1
ZDX-1/3 CS	CPVC	18	68	18	5.5	200°F/93°C	1/5	115/230	50/60	1	TEFC	10	4.5	12	5.4
ZKX-1/3 BS	PVDF	18	68	18	5.5	210°F/99°C	1/6	115/230	50/60	1	TEFC	22	10	26	11.8
ZDX-1/2 BS	CPVC	44	166	22	6.7	200°F/93°C	1/4	115/230 or 208-230/380-460	50/60	1 or 3	TEFC	22	10	26	11.8
ZKX-1/2 BS	PVDF	44	166	22	6.7	210°F/99°C	1/4	115/230 or 208-230/380-460	50/60	1 or 3	TEFC	22	10	26	11.8
ZDX-3/4AS	CPVC	60	227	28	8.5	200°F/93°C	3/4	115/230 or 208-230/380-460	50/60	1 or 3	TEFC	33	15	39	17.7
ZDX-1BSE	CPVC	76	288	50	15.2	200°F/93°C	1	115/230 or 208-230/380-460	50/60	1 or 3	TEFC	48	21.7	55	25
ZDX-2CS	CPVC/GFPY	104	394	63	19.2	200°F/93°C	2	208-230/380-460	50/60	3	TEFC	58	26.3	65	29.5
ZDX-3S	CPVC	110	416	84	25.6	165°F/74°C	3	190/380-230/460	50/60	3	TEFC	80	36.3	88	40
ZDX-5	CPVC	132	500	123	37.5	165°F/74°C	5	190/380-230/460	50/60	3	TEFC	105	47.6	113	51.2

*Electric motors can be ordered wired with on-off switch and heavy duty grounded line cord. A grounded plug is included with wired 115 Volt motors. A manual reset circuit breaker or internal thermal overload is included with each wired single phase motor. Customer supplied external overload protection is required on 3 phase motors. Motors are wired for low voltage unless specified otherwise.

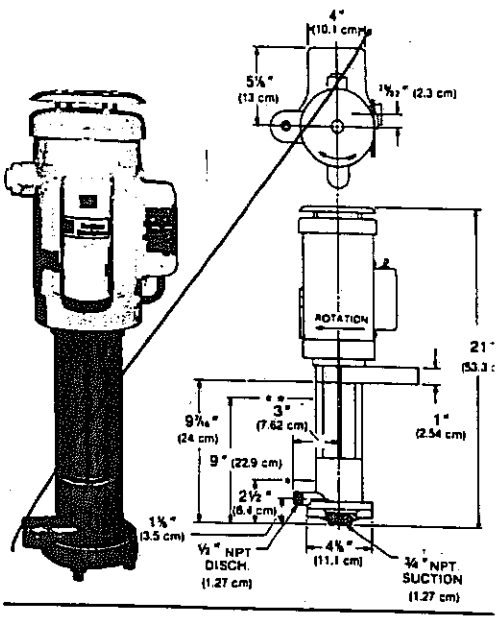
ZDX-1/12CS



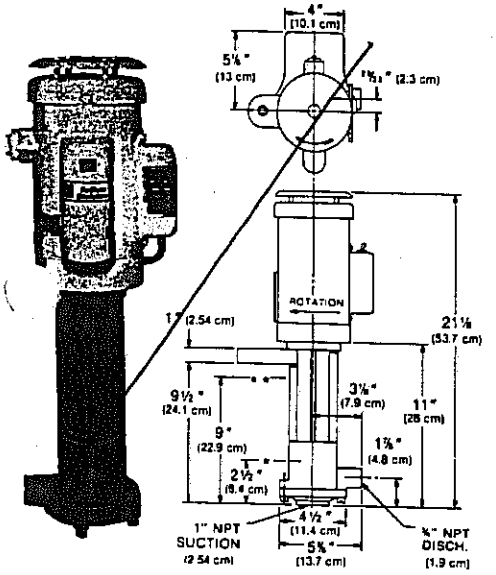
ZDX-1/3CS (Compact)



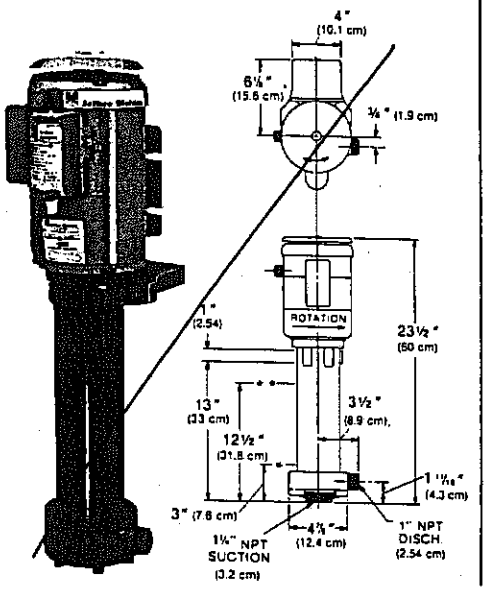
ZKX-1/3BS



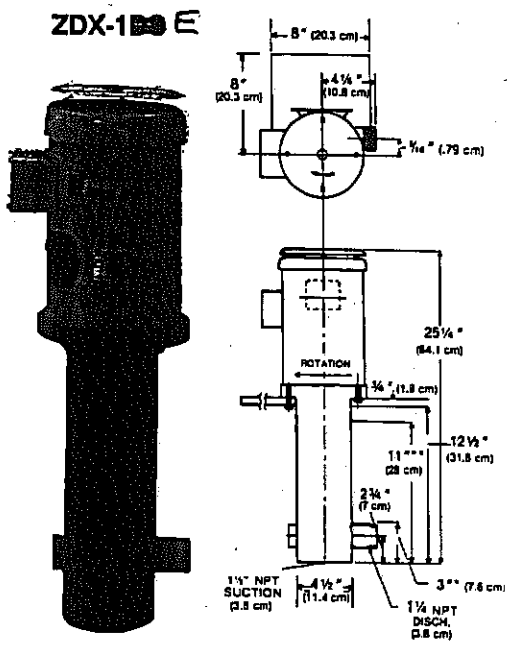
ZDX-1/2BS & ZKX-1/2BS



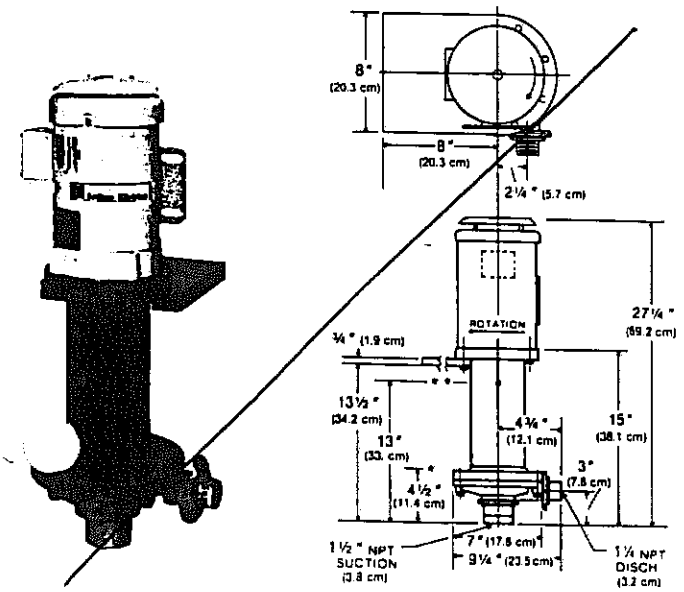
ZDX-3/4AS



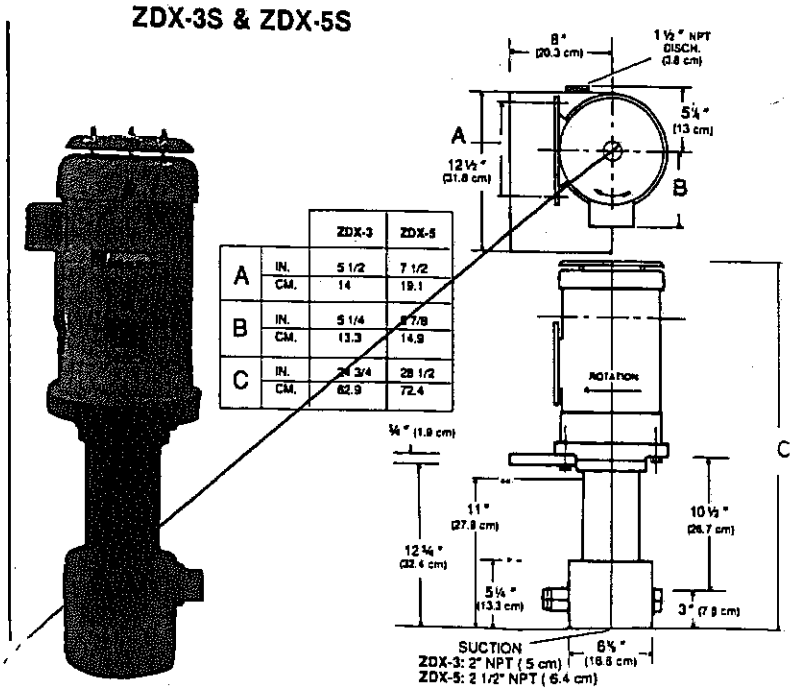
ZDX-1



ZDX-2CS



ZDX-3S & ZDX-5S



		ZDX-3	ZDX-5
A	IN.	5 1/2	7 1/2
	CM.	14	19.1
B	IN.	5 1/4	5 7/8
	CM.	13.3	14.9
C	IN.	24 3/4	28 1/2
	CM.	62.9	72.4

Please Note: For clarity, dimensional drawings depict certain parts rotated from their normal position. All pumps are viewed from the motor end.

SETHCO "ZDX SERIES" BEARING FREE SEALLESS VERTICAL PUMPS

All Sethco "ZDX" pumps are designed and built for rugged industrial service. They are fully field repairable should a part become damaged.

EASILY MOUNTS TO TANK

By means of a convenient mounting panel, the pump can be set in a self-priming position in-tank, or outside the tank, as necessary.

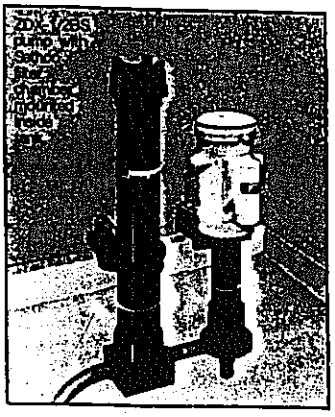
MOTORS

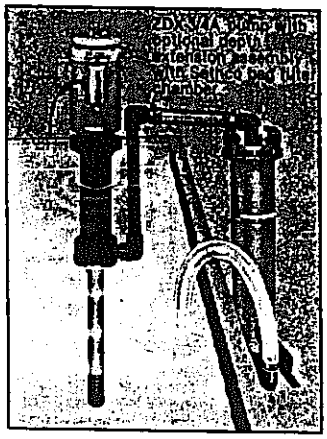
Sethco "ZDX" electric motors are all totally enclosed, fan cooled U.L. Recognized, CSA approved and continuous duty rated. The motors are protected by special corrosion resistant paint. In addition, they have a corrosion resistant drip cover. The motors are equipped with over-sized, double sealed ball-bearings, and have a solid one-piece shaft to prevent impeller whip and assure long life.

All 1/4 Horsepower and larger motors are equipped with a lip seal where the stainless steel shaft enters the motor. This helps prevent vapors and liquid from entering the motor.

ACCESSORIES

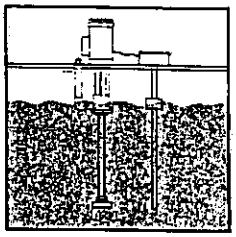
Sethco "ZDX" pumps can be equipped with Bottom Strainer Assembly that can be used to draw liquid from deep in the tank and recirculate it, or pump to another location. For initial priming the liquid must cover the lower impeller. If the pump should lose its prime because it has been stopped or the liquid level dropped below the pump inlet, the liquid level must again rise to cover the impeller before pumping can resume.





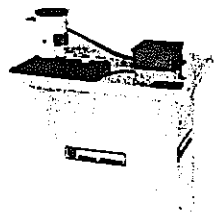
Liquid Level Control

Automatic liquid level controls are available for any ZDX pump. These controllers feature two magnetic reed switches and are prewired to turn the pump on at high level and off at low level. Additional switches may be added to control additional functions, such as turning on a second pump and/or an alarm. Refer to Bulletin 961 for details.



Pump Transfer Stations

Sethco ZDX pumps can be provided as part of a complete pump station. These systems include an appropriately sized pump, liquid level control, corrosion resistant tank, tank cover, and necessary fittings and hardware. Sethco pump stations are available in many standard, as well as custom sizes. See Bulletin 963 for details.



WARRANTY: One year warranty against defective parts and workmanship. See Form TC-01 for full warranty details. Always be specific about your application in order that proper materials may be furnished. Let Sethco or an authorized distributor know: liquids being handled, gallons, temperatures and pH.

The standard warranty does not apply when equipment is used contrary to factory recommendations.

Since the policy of Sethco is one of continual improvement, we reserve the right to change design or materials at any time, without giving notice or creating any obligation to previous or future customers.

MET PRO CORPORATION **Sethco Division**

70 ARKAY DRIVE, P.O. BOX 12128, HAUPPAUGE, N.Y. 11788-3773 • TEL: 516-435-0530 • FAX: 516-435-0654

230 NO. CRESCENT WAY, UNIT I • ANAHEIM, CA. 92801 • 714-991-0270 • FAX: 714-991-8107

PD-353-06

CPVC BEARING FREE VERTICAL PUMP

MODELS: ZDX-1E ZDX-2D

PARTS LIST

April 1, 1998

MET PRO CORPORATION **Sethco Division**

70 ARKAY DRIVE
P.O. BOX 12128
HAUPPAUGE, NEW YORK 11788-3773
TEL: 516-435-0530 • FAX: 516-435-0654 • WEBSITE: www.met-pro.com/Sethco.html
230 N. CRESCENT WAY, UNIT I, ANAHEIM, CA. 92801 • 714-991-0270 • FAX: 714-991-8107

MODEL: ZDX-1E, ZDX-2D

DISASSEMBLY

1. Remove snap ring (8) and inlet cover (7) from body assembly (4).
2. Insert screwdriver into motor end shaft slot to hold shaft stationary and unscrew impeller nut (9) standard RH thread.
3. Pull Impeller (5) off of motor shaft.
4. Remove bolts (2,11), body Assembly (4) and panel (12) from motor (1)

INSPECTION

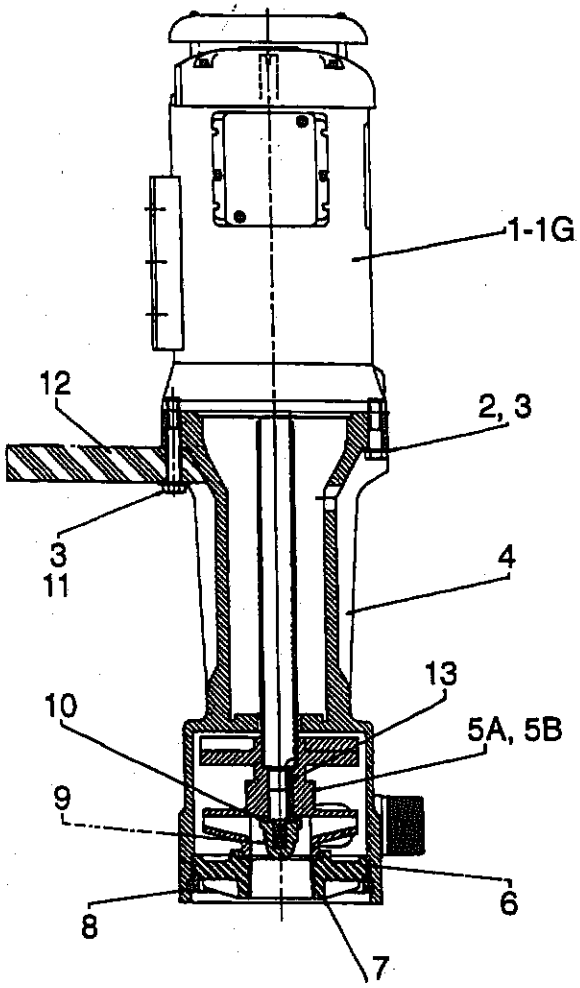
1. Check all internal and external threads for damage or stripped thread.
2. Check O-ring (10) for any wear and/or cracks, replace if necessary
3. Check impeller for cracks, abrasions and distortion.
4. Check shaft for run out and chemical attack.

REASSEMBLY

1. Secure body assembly (4) and panel (12) to motor (1) with bolts (2, 11).
2. Slide impeller (5) over motor shaft.
3. Insert screwdriver into slot end of motor shaft and thread impeller nut (9), standard RH thread.
4. Check both O-rings (6) for wear and/or cracks, replace if necessary.
5. Repace inlet cover (7) and secure to body assembly (4) with snap ring (8).

See reverse side for installation, operating instructions and trouble shooting

ALWAYS SPECIFY MODEL, SERIAL NUMBER, NAME, PART NUMBER AND THIS DRAWING NUMBER WHEN ORDERING



ITEM	NAME	REQ'D	MAT'L	PART NUMBER
1	Motor, 1 HP, Wired, 115V, 50/60Hz, 1ph **(ZDX-1E)**	1	–	575P01232313D4A
1a	Motor, 1 HP, Wired, 230V, 50/60Hz, 1ph **(ZDX-1E)**	1	–	576P01232313D4A
1b	Motor, 1 HP, Unwired, 230/460V, 50/60Hz, 3ph **(ZDX-1E)**	1	–	574P01236333D4A
1c	Motor, 1 HP, Wired 230V, 50/60Hz, 3ph **(ZDX-1E)**	1	–	575P01236333D4A
1d	Motor, 1 HP, Wired, 460V, 50/60Hz, 3ph **(ZDX-1E)**	1	–	576P01236333D4A
1e	Motor, 2 HP, Unwired, 230/460V, 50/60Hz, 3ph **(ZDX-2D)**	1	–	574P02236333D4A
1f	Motor, 2 HP, Wired, 230V, 50/60Hz, 3ph **(ZDX-2D)**	1	–	575P02236333D4A
1g	Motor, 2 HP, Wired 460V, 50/60Hz, 3ph **(ZDX-2D)**	1	–	576P02236333D4A
2	Bolt, Short	2 or 4	SS 304	790P0316104-680
3	Washer, 3/8"	4	SS 304	990P396807-680
4	Body Assembly	1	CPVC	060P301346-551
5A	Impeller Assembly **(ZDX-1E)**	1	CPVC	431P2019733-551
5B	Impeller Assembly **(ZDX-2D)**	1	CPVC	431P2019735-551
6	O-Ring	2	Viton	590P2248-830
7	Inlet Cover	1	CPVC	140P400294-551
8	Snap Ring	1	CPVC	700P4003172-551
9	Impeller Nut	1	CPVC	120P03162-551
10	O-ring	1	Viton	590P2021-830
11	Bolt, Long	2	SS 304	790P0316204-680
12	Panel	1	Poly-Pro	380P4002852-580
13	Impeller Key	1	SS 304	480P316103-680

CALL SETHCO OR A SETHCO DISTRIBUTOR FOR PRICES

PARTS LIST FOR SETHCO MODELS ZDX-1E & ZDX-2D VERTICAL PUMPS

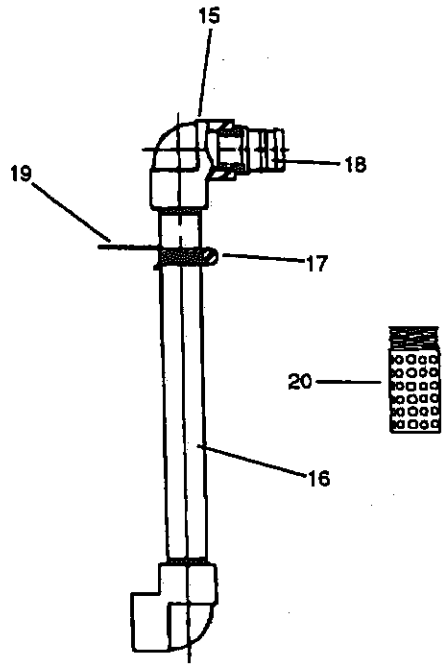
PRE-INSTALLATION

Before using your new Sethco pump, there is some background information that will be of value to you. All Sethco pumps are tested for proper operation. Before installing your new Sethco pump, the following is recommended:

- Determine that the merchandise checks against the packing slip for completeness of order. If there is a discrepancy, please notify Sethco immediately—preferably by phone and also confirm by mail.
- Check the pump for proper operation. This checkout cannot be as complete as an actual operational test; however, the following is suggested: Visually check the pump assembly for shipping damage. Also determine if any objects are lodged in the pump. Turn the shaft to determine that it is not bound. Damage to the drive motor can result from an excessive load.
- Examine mounting location for maintenance accessibility. After the hose has been connected and before the pump is installed, it is recommended that the system be flushed of dirt and plastic chips.

TROUBLESHOOTING

NO DISCHARGE	Pump not primed
	Speed too low
	System head too high
	Suction lift higher than that for which pump is designed
	Impeller or suction completely plugged
	Wrong direction of rotation
	Air leak in the suction line
INSUFFICIENT DISCHARGE	Air leaks in suction
	Speed too low
	System head higher than anticipated
	Insufficient NPSHA
	Impeller or suction partially plugged
	Impeller damaged
	Suction opening not submerged enough
	Wrong direction of rotation
INSUFFICIENT PRESSURE	Speed too low
	System head less than anticipated
	Air or gas in liquid
	Impeller damage
	Impeller diameter too small
	Wrong direction of rotation
EXCESS POWER CONSUMPTION	Speed too high
	System head lower than rating, pumps too much liquid
	Specific gravity or viscosity of liquid pumped is too high
	Mechanical defects:
	Shaft bent
	Rotating elements bind



DISCHARGE FITTINGS

ITEM	NAME	MATERIAL	REQ'D	PART NUMBER
15	Elbow	CPVC	2	270P102-551
16	Outlet Pipe	CPVC	1	593P10216-551
17	Clamp	Stainless Steel	3	130P20-680
18	Hose Adapter	CPVC	1	390P102102-551
19	Bracket, J-Clip	Stainless Steel	1	050P102481-680
20	Strainer	CPVC	1	870P1044-551

INSTALLATION AND OPERATING INSTRUCTIONS

- Your vertical pump is designed for mounting inside or outside the tank by means of the mounting panel.
- When pump is mounted outside the tank, the pump inlet should be kept as short as possible, with minimum restrictions, for easy priming and proper operation. Inlet piping should be at least as large as the pump inlet.
- Whether the pump is mounted inside our outside the tank, it must be positioned vertically so that upper vent slot is above the liquid level and the impeller is below the liquid level. Proper mounting prevents siphoning and aids priming.
- The pump can be primed by filling the inlet or discharge. (Priming tee may be required.) Care should be exercised not to overflow through upper vent slots.
- Refer to direction arrow on motor or parts illustration for proper rotation before running pump.

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TERMS AND CONDITIONS OF SALE

The terms and conditions stated below and on the face of any Met Pro Corp., Sethco Div. (referred to below as Sethco) quote or order form govern, and any order is accepted subject thereto. These terms and conditions supersede any terms and conditions on buyer's quote or order form or attachments thereto which are inconsistent with the provisions hereof.

Prices: All prices and specifications are subject to change without notice. Prices charged will be those in effect at time of shipment.

ORDERS: All orders are subject to acceptance by Sethco at its home office in Hauppauge, New York. All errors, clerical or otherwise, are subject to correction. When total net billing for material is less than the minimum charge in effect at the time of shipment, invoicing will be made at the minimum charge. Acceptance of all orders is subject to credit approval.

Taxes: Sethco's prices do not include sales, use or excise taxes. Consequently, in addition to the price quoted, the amount of any present or future taxes based on sale, use, manufacture or transportation shall either be paid by the buyer or the buyer shall provide Sethco with an acceptable exemption certificate.

TERMS: Terms of payment are net 30 days, F.O.B. Hauppauge, New York, unless otherwise stated on the face of any quote or order form.

Shipments: Scheduled shipping dates are approximate. Title to and risk of loss for the material shall pass to the buyer upon delivery thereof by Sethco to the carrier or delivery service.

Cancellation—All orders upon acceptance by Sethco cannot be cancelled without Sethco's written consent, and then only upon payment to Sethco of reasonable and proper cancellation charges.

Returns: No goods may be returned unless authorization in writing has been received from Sethco's home office. After authorization is received, all goods must be returned, freight prepaid, to our home office in Hauppauge, New York.

Warranty: Sethco warrants (unless otherwise written on the face of any quote or order form) that products of Sethco's manufacture are free of defects in material or workmanship. Any part, except as indicated below, proven to be defective within one year from date of shipment, after inspection by and to the satisfaction of Sethco, will be repaired or replaced free of charge, F.O.B. Hauppauge, New York, on return of such claimed defective part as outlined under "Returns" above. Excluded are new P80 pumps, motors and parts which are warranted for 90 days and new Carboy and Drum pumps, motors and parts other than P80 , which are warranted for 180 days. Also excluded are all used and/or reconditioned items and parts which carry no warranty, and all normal wearing parts such as, but not limited to, shafts, mechanical seals, bearing, gaskets, etc.

The liability of Sethco under this warranty, whether the claim is based on contract or negligence, shall in no case exceed the cost of repairing or replacing the part as herein provided, and upon expiration of the warranty period, all such liabilities shall terminate.

Sethco assumes no liability for equipment which has been tampered with or altered in any way, or for consequential loss or damage of any kind, and the buyer, by acceptance of such equipment, assumes all liability for the consequences of its use or misuse by the buyer, his employees, or others.

UNLESS THE BUYER HAS FURNISHED SETHCO WITH COMPLETE INFORMATION REGARDING THE INTENDED APPLICATION AND SERVICE REQUIREMENTS OF THE ITEMS ORDERED, SETHCO GUARANTEES ONLY THE IDENTITY OF THE MATERIALS USED IN THE CONSTRUCTION OF THE EQUIPMENT SHIPPED.

Within the meaning of this warranty a defect in any part of the equipment shall not operate to condemn the entire unit when such part is capable of being renewed, repaired or replaced. Sethco assumes no field expense for service or parts on equipment without written authority from Sethco. Sethco does not warrant motors, gauges, electrical control equipment or other products not manufactured by Sethco, such being subject to warranties as may be given by their respective manufacturers.

The foregoing warranty is made in lieu of all other warranties, guarantees, obligations or liabilities, expressed or implied, by Sethco or its representatives. All statutory or implied warranties, other than of title, are hereby expressly negated and excluded. All illustrations and provisions in specifications are descriptive and are not intended as warranties.

Since the policy of Sethco is one of continual improvement, we reserve the right to change design or materials at any time, without giving notice or creating any obligation to previous or future customers.

General: All goods manufactured by Sethco are produced under terms and conditions of employment which satisfy all requirements of the United States Fair Labor Standards Act of 1938, as amended.

Sethco certifies that to the best of its knowledge, information and belief, the prices quoted or charged do not exceed any maximum price permitted under any prevailing or applicable law, regulation or executive order.

Sethco further certifies that in accordance with Executive Order 11246, as amended and its fundamental policy it provides equal employment opportunity to all qualified individuals in terms of recruitment and hiring practices, and assures that there shall be absolutely no discrimination against any person on the grounds of race, religion, color, national origin, age or sex.

SAFETY RULES

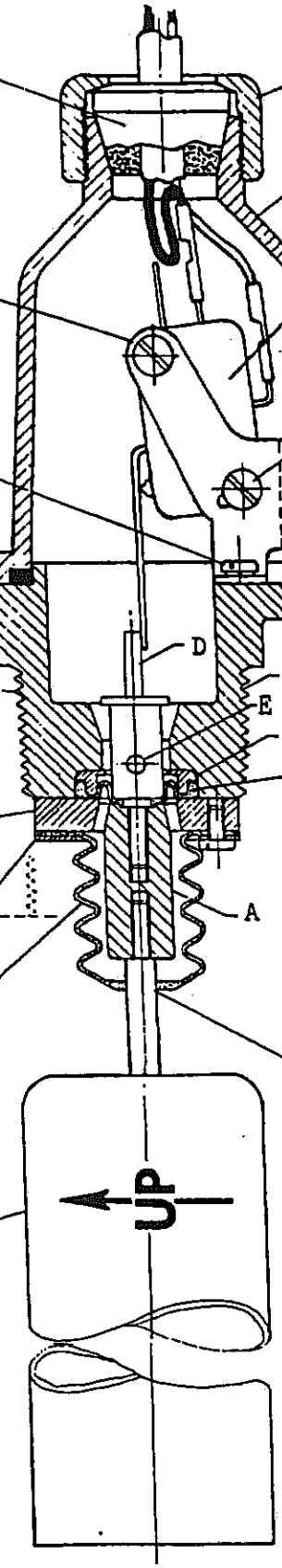
CONGRATULATIONS! You have just purchased a Sethco Pump, a quality industrial product manufactured to exacting standards.

To insure prolonged life of your purchase, please take a few minutes to review the operating instructions and become familiar with the pump.

Thank you for choosing a Sethco product. We look forward to serving your future requirements for quality industrial corrosion resistant pumps and filter supplies.

1. **KEEP BYSTANDERS AWAY** - All visitors and unauthorized persons should be kept a safe distance from work area.
2. **WEAR APPROPRIATE PROTECTIVE APPAREL** - Such as gloves, aprons, footwear and faceshields, etc. when installing, operating or maintaining the unit.
3. **KEEP HANDS AND FINGERS FROM IMPELLER.**
4. **KEEP FACE AWAY** - Don't look into hose, pump discharge, or suction.
5. **AUXILIARY EQUIPMENT** — Hoses must be suitable for the chemical to be transferred. They must also be selected to safely contain the pressure at the operating temperature. Clamps must not be attacked by any corrosive environment or splashing.
6. **DO NOT USE FOR** any other application unless written permission is obtained from the factory.
7. **ALL CONNECTIONS** — should be checked for secure and leakproof fit.
8. **NEVER** - Turn pump on unless valves are open.
9. When wiring motor, follow all electrical safety codes.
10. Always disconnect power source before performing any work on or near the motor or its connected load. Lock it in the open position and tag it to prevent unexpected application of power. Failure to do so could be fatal.
11. Be careful when touching exterior of a motor. It may be hot enough to be painful or cause injury. With modern motors this condition is normal if operated at rated load and voltage - modern motors are built to operate at higher temperatures.
12. Protect the power cable from sharp objects. Do not kink power cable and never allow the cable to come in contact with oil, grease, hot surfaces, or chemicals.
13. Do not handle the unit with wet hands or when standing in water as electrical shock could occur. Disconnect main power before handling unit for **ANY REASON!**
14. Isolate pump by closing suction and discharge valves prior to any maintenance. Attach lockouts to valves to prevent accidental opening.
15. No piping or foundation strains on pump are permitted. Any strain will cause misalignment and early failures.
16. **INSTALLATION - OPERATION - MAINTENANCE** of this equipment must be performed by trained and qualified personnel. Unauthorized handling of this equipment can be hazardous.

Low, High, & High-High Flow Switch



10403-6, GROMMET 'A'
-7, " 'AA'
-8, " 'B'
-9, " 'C'

10403-5, STRAIN RELIEF NUT

10403-2, COVER
-3, 4 RETAINING SCREWS (NOT SHOWN)

10403-18, MICROSWITCH BRACKET

10403-21, MICROSWITCH COMPLETE WITH 3 SLIP-ON TERMINALS

10403-19, 2 SCREWS
-20, 2 SPLIT LOCKWASHERS

10403-22, 2 SCREWS
-23, 2 NUTS
-24, 2 SPLIT LOCKWASHERS
-25, 1 PLAIN WASHER

10403-4, O-RING

10403-26, $1\frac{1}{4}$" x 1" BUSHING SUPPLIED

10403-1, BODY COMPLETE WITH
A) SEAL SHAFT
B) DIAPHRAGM
C) " WASHER
D) FEED THRU SHAFT
E) PIVOT PIN
F) CAP (SONICALLY WELDED)

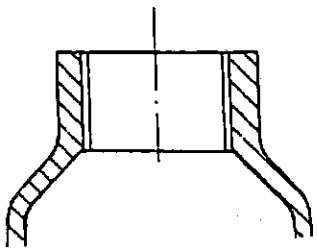
10403-13, FILTER BOOT CLAMP RING
-14, 3 RETAINING SCREWS

10403-12, FILTER BOOT

10403-15, FLOAT SHAFT

10403-16, FLOAT

IF FLOAT (10403-16) IS TO BE REMOVED FROM ASSEMBLY, FLOAT SHAFT (10403-15) MUST BE GRIPPED BY PLIERS OR IN A VICE TO PREVENT UNTHREADING FROM SEAL SHAFT (A).



'F' COVER TO SUIT CUSTOMER SUPPLIED FITTING FOR 1/2" FLEXIBLE CONDUIT

PARTS LIST – SPECIFICATIONS – INSTALLATION INSTRUCTIONS

MODEL L-30CR LIQUID LEVEL SWITCH DRG #10403

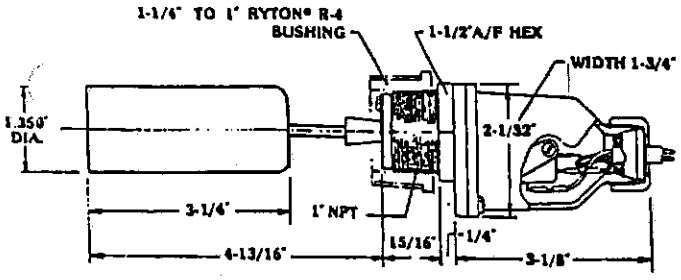
HARWIL CORPORATION

1548 17th ST., SANTA MONICA, CALIFORNIA 90404
(213) 829-2310

NOVEMBER 198

SPECIFICATIONS:

● **INSTALLATION DIMENSIONS:**



● **WETTED SURFACES:**
Ryton® R-4, Hastelloy® C, Viton®

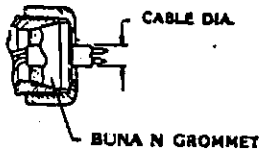
● **ELECTRICAL SWITCH CHARACTERISTICS:**
SPDT UL and CSA listed
15 amp, ½ HP @ 125 or 250 VAC
½ amp, @ 125 VDC, ¼ amp @ 250 VDC
5 amp @ 125 VAC (Tungsten lamp load)
10,000,000 operations median.

● **LIQUID LEVEL CHANGE TO ACTIVATE SWITCH:**
1/4"

● **WORKING FLUID SPEC. GRAV.**
0.9 min.

● **ELECTRICAL CABLE FITTING:**
Each unit is supplied with a water and oil resistant strain relief cable fitting with a choice of seal as below:

GROMMET SIZE	CABLE DIA. ±.025"
A	.250"
AA	.300"
B	.375"
C	.500"
F	Special cover provided to accept ½" flexible conduit, e.g. Sealflex or Spiraduct.



● **WEIGHT:**
1/4 lb.

● **MODEL L-30CR**
● **FLOAT:** Hollow Ryton® R-4
● **NOM. WORKING PRESSURE/TEMP.**

TEMP. (°F)	200 max.
PRESSURE (PSI)	100 max.

● **CORROSION RESISTANCE:**
Determined by wetted surfaces listed above.
An extensive chemical corrosive list is available on request.

MODEL L-30CR LIQUID LEVEL SWITCH
INSTALLATION AND OPERATING INSTRUCTIONS

INSTALLATION:

The L-30CR liquid level switch is supplied with a 1¼" x 1" Ryton R-4 bushing threaded in place with 2 to 3 wraps of teflon tape, which must be intact or renewed if bushing and switch are ...rated before assembly in tank. Care must be exercised when threading the bushing into p...stic or metal fittings. Apply a minimum of 2 to a maximum of 3 wraps of teflon tape to threads of bushing - this is especially important if unit is to be used in metal fittings where coarse METAL THREADS could gall plastic if not lubricated. The plastic bushing CAN BE CRACKED if the main body of the level switch is tightened into it FIRST. Cracking will not occur if the bushing is FIRST tightened into the pipe or tank fitting and THEN the L-30CR body is tightened into the bushing.

Thus: - Step 1. Teflon tape thread and tighten plastic bushing into pipe or tank fitting.

Step 2. Teflon tape thread and tighten L-30CR switch into PLASTIC bushing by applying wrench to hexagon section. Repeat steps 1 and 2 until ARROW on body points to UPWARD and threads are leak tight.

Plumbers' tools such as pipe wrenches are not recommended. If possible use a "Ridgid" type wrench where the smooth jaws closely fit the hexagon section.

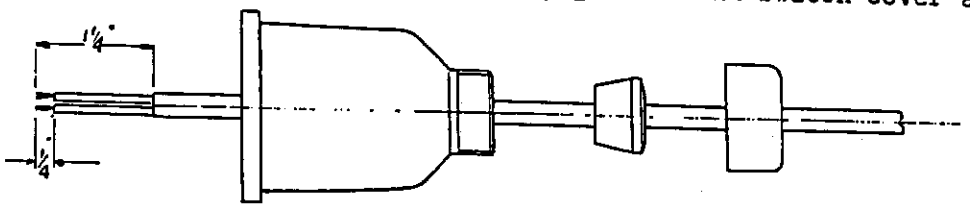
ELECTRICAL WIRING:

Step 1. Remove gland nut, grommet and switch cover.

Step 2. Strip outer jacket of electrical cord back approx. 1¼ inches. Strip insulation from individual conductors back approx. ¼ inch.

Step 3. Slip on terminals are supplied with each switch. Remove from switch terminals and crimp on or solder to electrical leads.

Step 4. Feed electrical cable through gland nut, grommet and switch cover as shown.



Step 5. Apply slip on terminals to appropriate contacts of microswitch.
Slide cover down cable and fasten to body of switch with 4 screws provided.
Slide grommet down cable until outer jacket is level with small end of grommet per illustration p.2.
Push grommet into tapered end of cover.
Hold cable jacket to prevent rotation and thread gland nut firmly on to cover.

FIG.1 Wiring schematic for power applied to load when liquid level is less than set point (power to load interrupted when level increases to above set point)

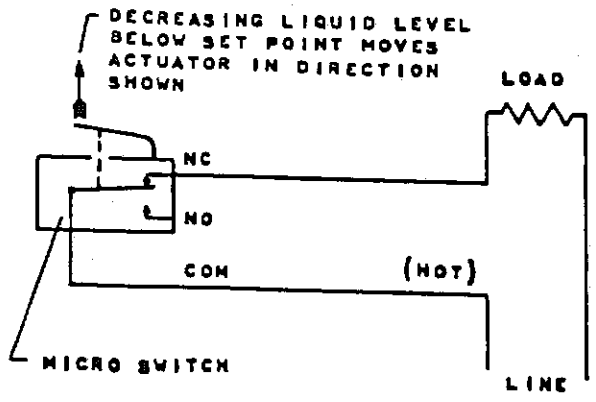
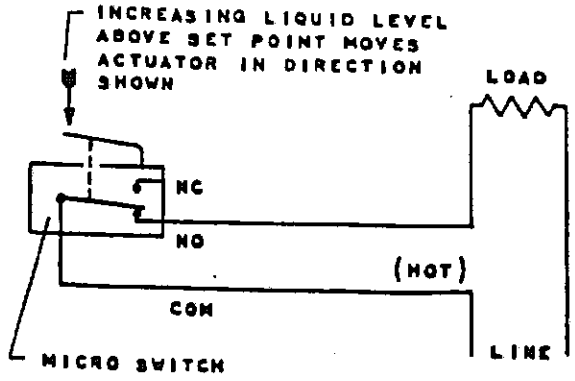


FIG. 2: Wiring schematic for power applied to load when liquid level is greater than set point (power to load interrupted when level decreases to below set point)



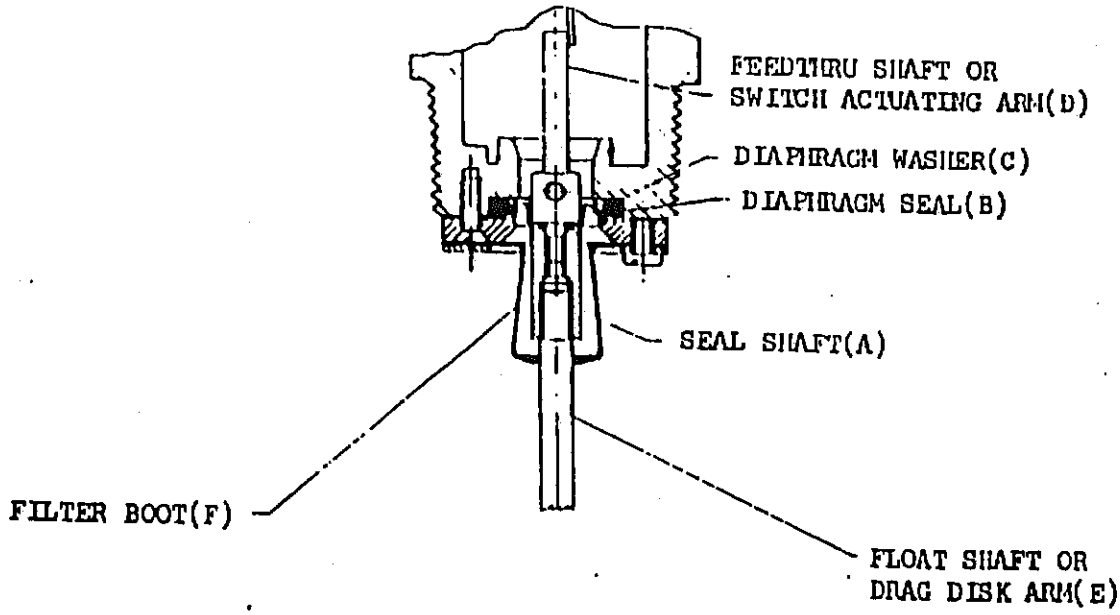
Micro switch actuation point may be monitored by an audible click or with an OHM meter before connecting line power to the terminal strip or by monitoring the voltage supplied to the load through the micro switch.

~~FLOW SWITCH MODELS NUMBER Q-8 AND Q-8CR~~

LIQUID LEVEL SWITCH MODELS NUMBER L-30 AND L-30CR

ALL THESE MODELS EMPLOY AN EXTERNAL SEAL SHAFT (A) A FLEXIBLE ELASTOMER DIAPHRAGM SEAL (B) AND AN INTERNAL FEED THRU SHAFT OR SWITCH ACTUATING ARM (D). ALL THREE ELEMENTS ARE ASSEMBLED AND LOCKED IN PLACE WITH LOCTITE ADHESIVE. TO PREVENT RUPTURE OF SEAL AND LEAKAGE INTO SWITCH AREA, IT IS CRITICALLY IMPORTANT THAT TORQUE NOT BE APPLIED TO SEAL SHAFT (A) FLOAT SHAFT (E) OR DRAG DISK ARM (E) DURING CHANGE OF FLOAT OR DRAG DISK.

IF FLOAT SHAFT OR DRAG DISK ARM (E) REQUIRE REPLACEMENT IT IS NECESSARY TO REMOVE FILTER BOOT (F). SEAL SHAFT (A) MUST THEN BE HELD FIRMLY IN A VISE OR WITH PLIERS WHILE (E) IS UNTHREADED AND A NEW SHAFT IS ASSEMBLED.



HARVILL CORPORATION

1340 17th ST., SANTA MONICA, CALIFORNIA 90404
(213) 829-2310

7200 SERIES

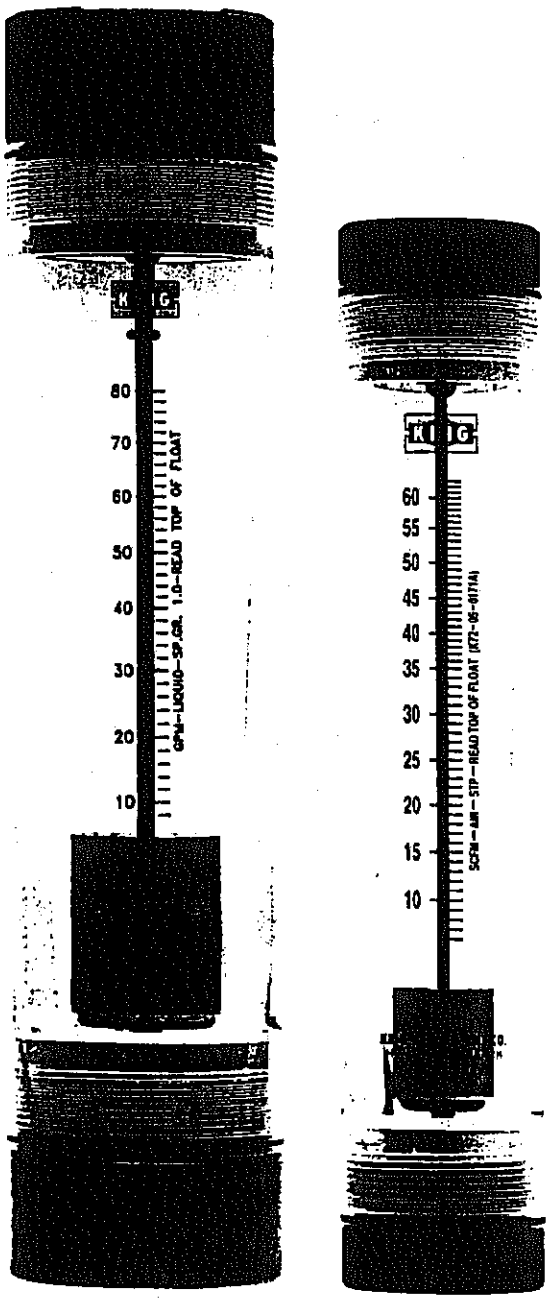
MEDIUM AND HIGH CAPACITY MODELS

SCALE LENGTH
127mm (5")

ACCURACY/REPEATABILITY
see table page 13

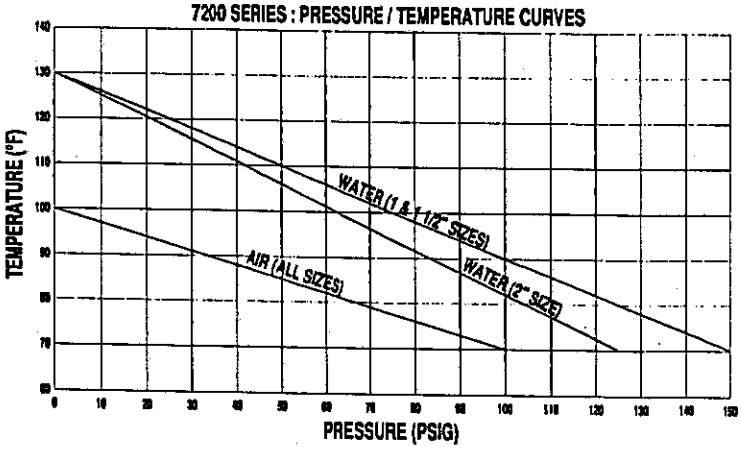
CAPACITIES
5 GPM to 200 GPM—Water
40 SCFM to 245 SCFM—Air

METERING TUBE MATERIAL
Machined Cast Acrylic



A real value in general purpose rotameters.

- Metering tubes are machined from American made solid cast acrylic rod. (Cast material is the most durable of all Acrylic resins.)
- Floats are rod guided.
- Scales are direct reading (GPM—Water or SCFM—Air).
- Special Scales are available.
- Meters have white screen printed backs for enhanced readability.
- Fittings thread into metering tubes.
- Meters have O-ring seals.
- Connections are in line type, NPT.
- Factory certified calibration is available.



CAUTION: Meters used in Air service are designed to operate at 14.7 psia. Air service meters used in pressure service must be shielded using 3/8" polycarbonate to protect personnel and equipment in the event of tube failure.

MATERIALS OF CONSTRUCTION

PART	STANDARD	OPTIONAL
Meter Tube	Acrylic	—
Fittings	PVC*	Brass, 316SS Aluminum
Float	316 Stainless Steel	—
Guide Rod	316 Stainless Steel	—
Float Stops	Polysulfone	—
O-rings	EPR	Viton®, Buna-N

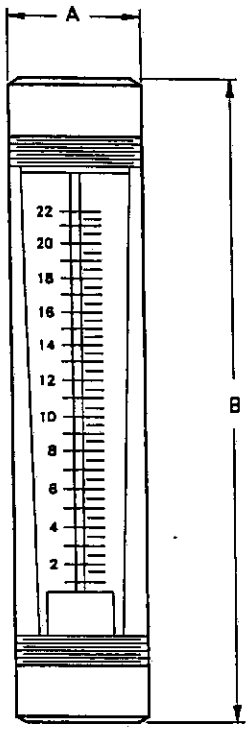
*Not for air service

GENERAL PURPOSE METERS

7200 SERIES

ORDER/CAPACITY INFORMATION

Order Number	Flow GPM–Water	Flow SCFM–Air	Accuracy/ Repeatability (±)	Press. Drop (In.W.C.)	Connection Size	Dimensions A	Dimensions B
0151	.5-5	2-20	3%/1%	10	1" FNPT	2"	10¼"
0161	1-10	4-43		12			
0171	1.5-15	6-62		18			
0181	2-21	—		22			
0191	3-30.5	—		26			
0201	4-40	—	6%/2%	32	1 1/2" MNPT	2"	12 1/16"
0211	8-50	—		38			
0221	4-40	15-165	4%/1%	18	2" FNPT	3"	13¼"
0231	6-60	25-245		25			
0241	8-80	—		30			
0251	20-100	—		35			
0261	30-120	—	6%/2%	45			
0271	45-160	—		60			
0281	55-200	—		80			



ORDERING PROCEDURE ORDER #

(Exact Sequence Must Be Followed)

7	2	0	5	0	2	1	1	3	1	W
1	2	3	4	5	6	7	8	9	10	11

Material: Order #

1. Specify Meter Series (Positions: 1-4) — 7205:
2. Specify Flow Range/ Order Number from table above: (Position: 5-8)
3. Specify Fitting Material (Position: 9) — PVC (not for air service): 3; Brass: 1; 316 Stainless Steel: 2; Aluminum: 6
4. Specify O-Ring Material (Position: 10) — EPR: 1; Buna-N: 2; Viton®: 3
5. Specify Fluid To Be Metered (Position: 11) — GPM—Liquid: W; SCFM—Air: A

Viton® is a registered trademark of E. I. DuPont.

INSTALLATION INSTRUCTIONS

You are about to install a fine piece of flow measuring equipment. To get the most from it and your system take time to read the following information before beginning work.

1. Carefully inspect the meter for damage that may have occurred during shipping.
2. Make sure your pressure, temperature and other requirements are compatible with the meter.*
3. Select a suitable location for installation to prevent excess stress on the meter which may result from:
   a. Misaligned pipe.
   b. The weight of related plumbing.
   c. "Water Hammer," which is most likely to occur when flow is suddenly stopped as with quick closing and solenoid operated valves. (If necessary a surge chamber should be installed. This will also be useful in high pressure start-up situations.)
   d. Thermal expansion of liquid in a stagnated or valve isolated system. (If necessary install valving which will allow the meter to be drained when not in use.)

   NOTE: In closed thermal transfer or cooling systems install the meter in the cool side of the line to minimize meter expansion and contraction and possible related fluid leaks.
4. Handle the meter carefully during installation. Use a leather, plastic or fabric strap wrench on meters with round fittings.
   a. Do not use pliers or wrenches to hold the metering tube.
   b. **DO NOT OVERTIGHTEN PLUMBING CONNECTION INTO FITTINGS.** Overtightening will cause fittings to fracture.
   c. Use an appropriate amount of teflon tape on external pipe threads before making connections. Do not use paste or stick type thread sealing products.
   d. Do not expose the meter to solvents or solvent fumes (e.g., PVC cement)
5. Install the meter vertically with the inlet port at the bottom.
6. Meters used in gas service (other than at 14.7 psia) should be sufficiently shielded to protect individuals and property from highly dangerous flying debris that would result from meter failure.
7. Meters are neither explosion proof nor oxygen cleaned, so extra caution should be used in explosive gas or oxygen service. **Meters are not specifically recommended for service other than water or air. The user must determine meter suitability for use with other fluids.**
8. Serious property damage and personal injury or even loss of life could occur as the result of a meter used in an unsuitable application.

PRESSURE/TEMPERATURE GUIDELINES*

K71, K72 SERIES FLOWMETERS

Acrylic Tube — PVC Fittings	
Tube Diameter (Inches)	(PSIG / °F
1¼	150 / 130
1½	150 / 130
1¾	150 / 130
2	150 / 130
3	125 / 130

NOTE: Meters made from TPX (Polymethylpentene) are not recommended for pressures above 20 psig at 70°F. The heat deflection temperature of TPX is 185°F.

K74 SERIES GLASS TUBE FLOWMETERS

Standard PVC Fittings	Optional PVDF Fittings
(PSIG / °F)	(PSIG / °F)
180 / 140	200 / 190

K75 SERIES PANEL MOUNT FLOWMETERS

Standard — Acrylic Block, PVC Fittings
(PSIG / °F)
100 / 100

7830, 7330 SERIES FREE STANDING FLOWMETERS

Tube Size	Polysulfone Tube PVC Fittings	Polyamide Tube PVC Fittings
	(PSIG / °F)	(PSIG / °F)
4, 5, 6	150 / 130	125 / 120
8, 9	125 / 130	125 / 120

*The maximum pressure suggested is at a temperature of 70°F. The maximum temperature suggested is at 0 psi, so pressure and temperature maximums are inversely proportional.

PRESSURE/TEMPERATURE GUIDELINES 7810, 7820, 7310, 7320**

7810, 7310 SERIES STAINLESS CASE FLOWMETERS

Tube Size	Polysulfone Tube — Metal Fittings		Polyamide Tube — Metal Fittings	
	Maximum Temperature	Maximum Pressure	Maximum Temperature	Maximum Pressure
4, 5, 6	200°F	225 PSIG	125°F	225 PSIG
8, 9	200°F	160 PSIG	125°F	160 PSIG

7820, 7320 SERIES FRAME CONSTRUCTION FLOWMETERS

Tube Size	Polysulfone Tube Metal Fittings		Polysulfone Tube PVC Fittings		Polyamide Tube Metal Fittings		Polyamide Tube PVC Fittings	
	Maximum Temperature	Maximum Pressure	Maximum Temperature	Maximum Pressure	Maximum Temperature	Maximum Pressure	Maximum Temperature	Maximum Pressure
4, 5, 6	180°F	150 PSIG	130°F	125 PSIG	120°F	150 PSIG	120°F	125 PSIG
8, 9	180°F	125 PSIG	130°F	100 PSIG	120°F	125 PSIG	120°F	100 PSIG

**7810 / 7820 and 7310 / 7320 pressure and temperature guidelines are rated simultaneously.

NOTE: Pressure and temperature guidelines are for water applications. They are based on a study of the engineering data for particular materials used in construction and on the design of individual models. This information is supplemented by independent laboratory test results. Meters exposed to difficult environments such as those created by certain chemicals, excessive vibration or other stress inducing factors could fail at or below the suggested maximums. We are happy to pass along chemical compatibility information that has been published by the manufacturers of raw materials used in our products; however, this information should not in any way be construed as a recommendation made by King Instrument Company for a specific application.

KING INSTRUMENT COMPANY 16792 Burke Lane, Huntington Beach, CA 92647 • (714) 841-3663

2 WAY PILOT OPERATED
General Service Solenoid Valves

Brass or Stainless Steel Bodies • 3/8" to 2½" N.P.T.

ASCO
Red-Hat · Red-Hat II
8210 SERIES

1ST: 2ND STAGE 8210G4 3RD STAGE 8210G9

Specifications

Solenoid Enclosures: Valves listed in this series have either Red-Hat metal solenoid enclosures or Red-Hat II molded epoxy solenoids. Red-Hat II valves are identified by the change letter "G" in their catalog numbers, e.g., 8210G4, and are shown in red.

Standard Enclosures:
Red-Hat — Type 1 General Purpose

Red-Hat II — Types 1, 2, 3, 3S, 4 and 4X Combination General Purpose and Watertight.

Optional Enclosures:
Red-Hat — Types 3, 7 and 9 Combination Explosionproof and Raintight. To order, add prefix "EF" to catalog number. (Except Catalog Numbers 8210B57, 8210B58 and 8210B59)⑥

Red-Hat II — Types 3, 3S, 4, 4X, 6, 6P, 7 and 9 Combination Explosionproof and Watertight. To order, add prefix "EF" to catalog number.

tional constructions are available. The Optional Electrical Features Section, page 11, contains descriptions and ordering information for: Open Frame Solenoids • Junction Box Enclosures • Panel Mount Constructions.

Electrical: Standard Voltages:
24, 120, 240, 480 volts, AC, 60 Hz (or 110, 220 volts, AC, 50 Hz)

6, 12, 24, 120, 240 volts, DC

Other voltages are available when required.

Coil: Continuous duty molded Class F or H, as listed.

Nominal Ambient Temperature Ranges: Red-Hat and Red-Hat II Valves/AC Construction: 32°F. to 125°F.

Red-Hat Valves/DC Construction: 32°F. to 77°F. (104°F. occasionally).

Red-Hat II Valves/DC Construction: 32°F. to 104°F.
Refer to Engineering Section for details.

Valve Parts in Contact with Fluids:
Body — Brass or Stainless Steel, as listed
Seals and Discs — Buna "N" or Teflon*, as listed
Disc Holder — Nylon, as listed
Core Tube — 305 s.s.
Core and Plugnut — 430F s.s.
Springs — 302 s.s.
Shading Coil — Copper (brass body); Silver (stainless steel body)

Approvals: CSA certified.
UL listed as indicated. Refer to Engineering Section for details.

Ordering Information:
Important: We must have catalog number, voltage and Hertz, operating pressure and fluid handled. Use strainers with solenoid valves.

*DuPont Co. trademark

SPECIFICATIONS

Pipe Size (Ins.)	Orifice Size (Ins.)	Cv Flow Factor	Operating Pressure Differential (psi) Min.	Max. AC Air-Inert Gas	Max. AC Water	Max. AC Light Oil @ 300 SSU	Max. DC Air-Inert Gas	Max. DC Water	Max. DC Light Oil @ 300 SSU	Max. Fluid Temp.°F. AC	Max. Fluid Temp.°F. DC	Standard Solenoid Enclosures Red-Hat–Type 1 Red-Hat II–Types 1,2,3,3S,4 and 4X Brass Body Catalog Number	Brass Body Constr. Ref. No. ⑤	Brass Body UL Listing	S.S. Body Catalog Number	S.S. Body Constr. Ref. No. ⑤	S.S. Body UL Listing	Watt Rating/ Class of Coil Insulation ⑦ AC	Watt Rating/ Class of Coil Insulation ⑦ DC
NORMALLY CLOSED (Closed when de-energized), Buna "N" or Teflon② Seating																			
3/8	3/8	1.5	①	150	125	—	40	40	—	180	150	8210G73③	1P	•	8210G36③	1P	•	6.1/F	11.6/F
3/8	5/8	3	0	150	150	—	40	40	—	180	150	8210G93	5D	o	—	—	—	10.1/F	11.6/F
3/8	5/8	3	5	200	150	135	125	100	100	180	150	8210G1	6D	o	—	—	—	6.1/F	11.6/F
3/8	5/8	3	5	300	300	300	—	—	—	175	—	8210G6	5D	o	—	—	—	17.1/F	—
1/2	7/16	2.2	①	150	125	—	40	40	—	180	150	8210G15③	2P	•	8210G37③	2P	•	6.1/F	11.6/F
1/2	5/8	4	0	150	150	—	40	40	—	180	150	8210G94	5D	o	—	—	—	10.1/F	11.6/F
1/2	5/8	4	0	150	150	125	40	40	—	175	150	—	—	—	8210G87	7D	•	17.1/F	11.6/F
1/2	5/8	4	5	200	150	135	125	100	100	180	150	8210G2	6D	o	—	—	—	6.1/F	11.6/F
1/2	5/8	4	5	300	300	300	—	—	—	175	—	8210G7	5D	o	—	—	—	17.1/F	—
3/4	5/8	5	0	150	150	125	40	40	—	175	150	—	—	—	8210G88	7D	•	17.1/F	11.6/F
3/4	3/4	5	5	125	125	125	100	90	75	180	150	8210G9	9D	o	—	—	—	6.1/F	11.6/F
3/4	3/4	5	0	150	150	—	40	40	—	180	150	8210G95	8D	o	—	—	—	10.1/F	11.6/F
3/4	3/4	6.5	5	250	150	100	125	125	125	180	150	8210G3	11D	o	—	—	—	6.1/F	11.6/F
3/4	3/4	6	0	350	300	200	200	180	180	200	77	8210B26②⑪	10P	⑤	—	—	—	15.4/F	30.6/H
1	1	13	0	150	125	125	100	100	80	180	77	8210B54⑪	31D	⑤	8210D89	15D	⑤	15.4/F	30.6/H
1	1	13	5	150	150	100	125	125	125	180	150	8210G4	12D	o	—	—	—	6.1/F	11.6/F
1	1	13.5	0	300	225	115	—	—	—	200	—	8210B27	14P	•	—	—	—	20/F	—
1¼	1⅛	15	0	150	125	125	100	100	80	180	77	8210B55⑪	32D	⑤	—	—	—	15.4/F	30.6/H
1¼	1⅛	15	5	150	150	100	125	125	125	180	150	8210G8	16D	o	—	—	—	6.1/F	11.6/F
1½	1¼	22.5	0	150	125	125	100	100	80	180	77	8210B56⑪	33D	⑤	—	—	—	15.4/F	30.6/H
1½	1¼	22.5	5	150	150	100	125	125	125	180	150	8210G22	18D	•	—	—	—	6.1/F	11.6/F
2	1¾	43	5	150	125	90	50	50	50	180	150	8210G100	20P	•	—	—	—	6.1/F	11.6/F
2½	1¾	45	5	150	125	90	50	50	50	180	150	8210G101	21P	•	—	—	—	6.1/F	11.6/F

INSTALLATION AND MAINTENANCE INSTRUCTIONS

2-WAY INTERNAL PILOT OPERATED SOLENOID VALVES PISTON TYPE – 3/8 AND 1/2 NPT NORMALLY CLOSED OPERATION

BULLETINS
8210
8211

ASCO

Form No. V-5310R2

DESCRIPTION

Bulletin 8210 valves are 2-way normally closed internal pilot operated solenoid valves. Valves have a 'Y' type body of brass or stainless steel construction. Standard valves have a General Purpose NEMA Type 1 Solenoid Enclosure.

Bulletin 8211's are the same as Bulletin 8210's except the solenoids are equipped with an enclosure which is designed to meet NEMA Type 4 - Watertight, NEMA Type 7 (C or D) Hazardous Locations - Class I, Group C or D and NEMA Type 9 (E, F or G) Hazardous Locations - Class II, Groups E, F or G. Installation and maintenance instructions for explosion-proof/watertight solenoid enclosures are shown on Form Nos. V-5380 and V-5391.

OPERATION

Normally Closed: Valve is closed when solenoid is de-energized. Valve opens when solenoid is energized.

MANUAL OPERATOR (Optional)

Valves with Suffix "MO" in the catalog number are provided with a manual operator which allows manual operation when desired or during an interruption of electrical power. To operate valve manually, turn stem 180°. Valve will be in the same position as when the solenoid is energized. Disengage manual operator by turning stem 180°. CAUTION: Stem must be returned to original (normally closed) position before operating valve electrically.

INSTALLATION

Check nameplate for correct catalog number, pressure, voltage and service.

TEMPERATURE LIMITATIONS

For maximum valve ambient and fluid temperatures, refer to chart. The temperature limitations listed are for UL applications. For non UL applications, higher ambient and fluid temperature limitations are available. Consult factory. Check catalog number on nameplate to determine maximum temperatures.

Construction	Coil Class	Catalog Number Prefix	Maximum Ambient Temp. °F	Maximum Fluid Temp. °F
A-C Construction (Alternating Current)	A	None	77	180
	F	FT	122	180
	H	HT	140	180
D-C Construction (Direct Current)	A, F or H	None, FT or HT	77	150

POSITIONING/MOUNTING

This valve is designed to perform properly when mounted in any position. However, for optimum life and performance, the solenoid should be mounted vertical and upright so as to reduce the possibility of foreign matter accumulating in the core tube area. For mounting bracket (optional feature) dimensions, refer to Figure 1.

PIPING

Connect piping to valve according to markings on valve body. Apply pipe compound sparingly to male pipe threads only; if applied to valve threads, it may enter the valve and cause operational difficulty. Pipe strain should be avoided by proper support and alignment of piping. When tightening pipe, do not use valve as a lever. Wrenches applied to valve body or piping are to be located as close as possible to connection point.

IMPORTANT: For the protection of the solenoid valve, install a strainer or filter suitable for the service involved in the inlet side as close to the valve as possible. Periodic cleaning is required depending on the service conditions. See Bulletins 8600, 8601 and 8602 for strainers.

WIRING

Wiring must comply with Local and National Electrical Codes. Housings for all solenoids are provided with connections for 1/2 inch conduit. Solenoid enclosure may be rotated to facilitate wiring by removing the retaining cap or clip. CAUTION: When metal retaining clip disengages, it will spring upward. Rotate enclosure to desired position. Replace retaining cap or clip before operating.

NOTE: Alternating Current (A-C) and Direct Current (D-C) solenoids are built differently. To convert from one to the other, it is necessary to change the complete solenoid including the solenoid base sub-assembly and core assembly.

SOLENOID TEMPERATURE

Standard catalog valves are supplied with coils designed for continuous duty service. When the solenoid is energized for a long period, the solenoid enclosure becomes hot and can be touched with the hand only for an instant. This is a safe operating temperature. Any excessive heating will be indicated by the smoke and odor of burning coil insulation.

MAINTENANCE

WARNING: Turn off electrical power supply and depressurize valve before making repairs. It is not necessary to remove the valve from the pipe line for repairs.

CLEANING

A periodic cleaning of all solenoid valves is desirable. The time between cleanings will vary, depending on media and service conditions. In general, if the voltage to the coil is correct, sluggish valve operation, excessive leakage or noise will indicate that cleaning is required. Be sure to clean valve strainer or filter when cleaning solenoid valve.

PREVENTIVE MAINTENANCE

1. Keep the medium flowing through the valve as free from dirt and foreign material as possible.
2. While in service, operate the valve at least once a month to insure proper opening and closing.
3. Periodic inspection (depending on media and service conditions) of internal valve parts for damage or excessive wear is recommended. Thoroughly clean all parts. Replace any parts that are worn or damaged.

Form No. V-5310R2 PRINTED IN U.S.A. 1976 Automatic Switch Co.

ASCO Valves
FLORHAM PARK, NEW JERSEY 07932

IMPROPER OPERATION

1. **Faulty Control Circuit:** Check the electrical system by energizing the solenoid. A metallic click signifies that the solenoid is operating. Absence of the click indicates loss of power supply. Check for loose, blown-out fuses, open circuited or grounded coil, broken lead wires or spliced connections.
2. **Burned-Out Coil:** Check for open-circuited coil. Replace coil if necessary.
3. **Low Voltage:** Check voltage across the coil leads. Voltage must be at least 85% of nameplate rating.
4. **Incorrect Pressure:** Check valve pressure. Pressure to valve must be within range specified on nameplate.
5. **Excessive Leakage:** Disassemble valve and clean all parts. Replace worn or damaged parts with a complete Spare Parts Kit for best results.

COIL REPLACEMENT (Refer to Figures 1 and 2)

Turn off electrical power supply and disconnect coil lead wires. Proceed in the following manner:

1. Remove retaining cap or clip, nameplate and cover (housing on D-C Construction). CAUTION: When metal retaining clip disengages, it will spring upward.
2. For A-C Construction, slip yoke containing coil, sleeves and insulating washers off the solenoid base sub-assembly. For D-C Construction, slip spring washer, coil and insulating washers off the solenoid base sub-assembly. Insulating washers are omitted when a molded coil is used.
3. Reassemble in reverse order of disassembly paying careful attention to exploded views provided for identification and placement of parts.

CAUTION: Solenoid must be fully reassembled as the housing and internal parts are part of and complete the magnetic circuit. Place insulating washer at each end of coil, if required.

VALVE DISASSEMBLY

Depressurize valve and turn off electrical power supply. For A-C Construction, refer to Figure 1. For D-C Construction, refer to Figure 2. Proceed in the following manner:

1. Disassemble valve in an orderly fashion paying careful attention to exploded views provided for identification of parts.
2. Remove retaining cap or clip and slip the entire solenoid enclosure off the solenoid base sub-assembly. CAUTION: When metal retaining clip disengages, it will spring upward. For A-C Construction, remove fluxplate from solenoid base sub-assembly.
3. Unscrew solenoid base sub-assembly.
4. Remove core assembly, core spring, body gasket and piston assembly with piston ring attached.
5. For normal maintenance, it is not necessary to disassemble the manual operator unless external leakage is evident. To disassemble, remove stem pin, manual operator stem with stem gasket attached.
6. All parts are now accessible for cleaning or replacement. Replace worn or damaged parts with a complete Spare Parts Kit for best results.

VALVE REASSEMBLY

1. Reassemble in reverse order of disassembly paying careful attention to exploded views provided for identification and placement of parts.
2. Replace piston assembly, body gasket, core assembly and core spring. Wide end of core spring goes in the core first, closed end protrudes from the top of the core.
3. Replace solenoid base sub-assembly and torque to 175 ± 25 inch pounds.
4. If removed, replace stem gasket, manual operator stem and stem pin.
5. Replace solenoid enclosure and retaining cap or clip.
6. After maintenance, operate the valve a few times to be sure of proper opening and closing.

SPARE PARTS KITS

Spare Parts Kits and Coils are available for ASCO valves.
Parts marked with an asterisk (*) are supplied in Spare Parts Kits.

ORDERING INFORMATION FOR SPARE PARTS KITS
When Ordering Spare Parts or Coils Specify Valve Catalog Number, Serial Number and Voltage.

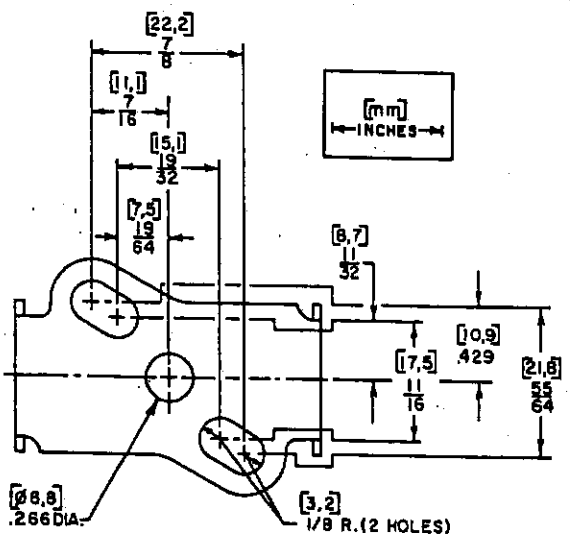


Figure 1. Dimensions For Mounting Bracket (Optional Feature)

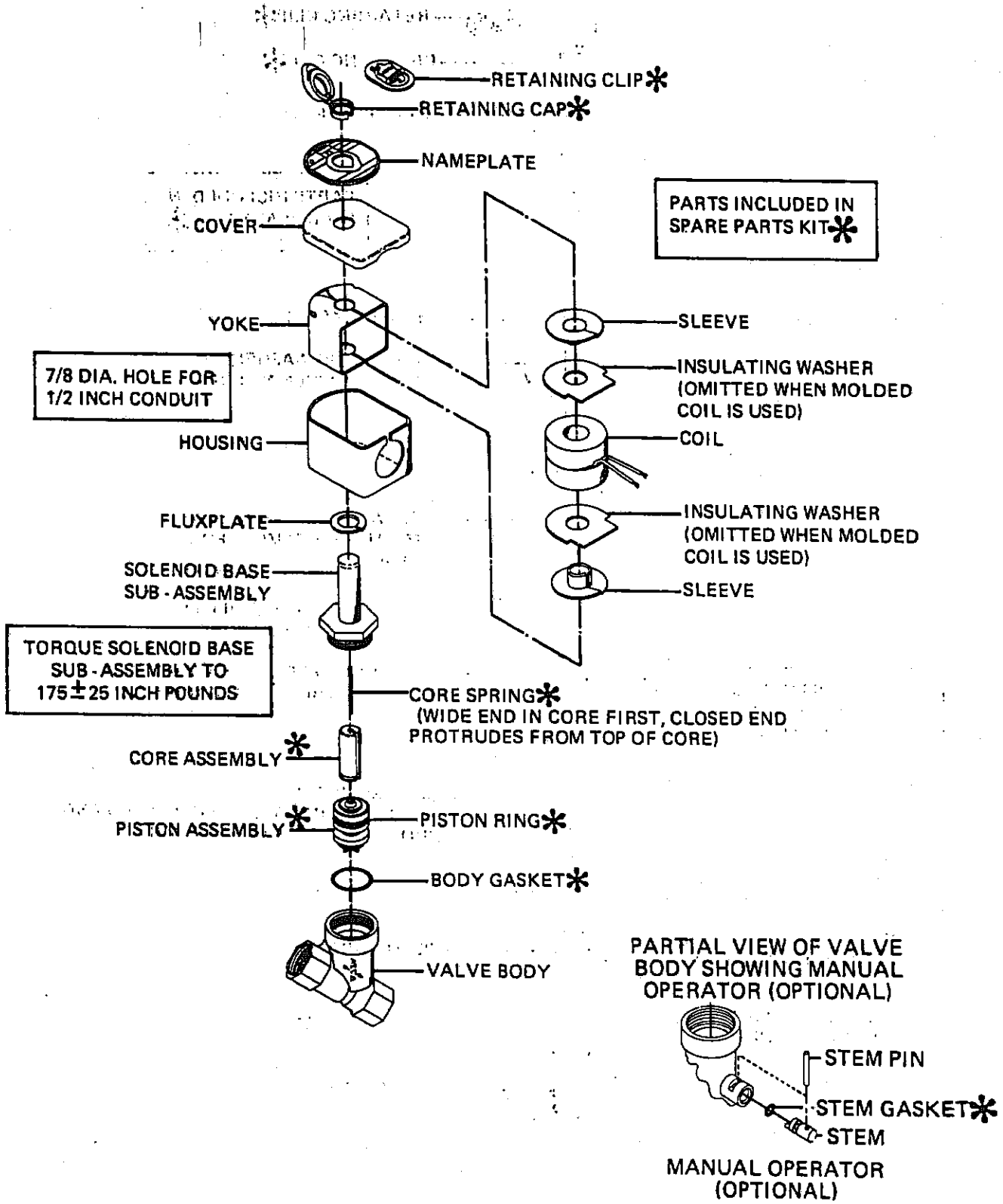
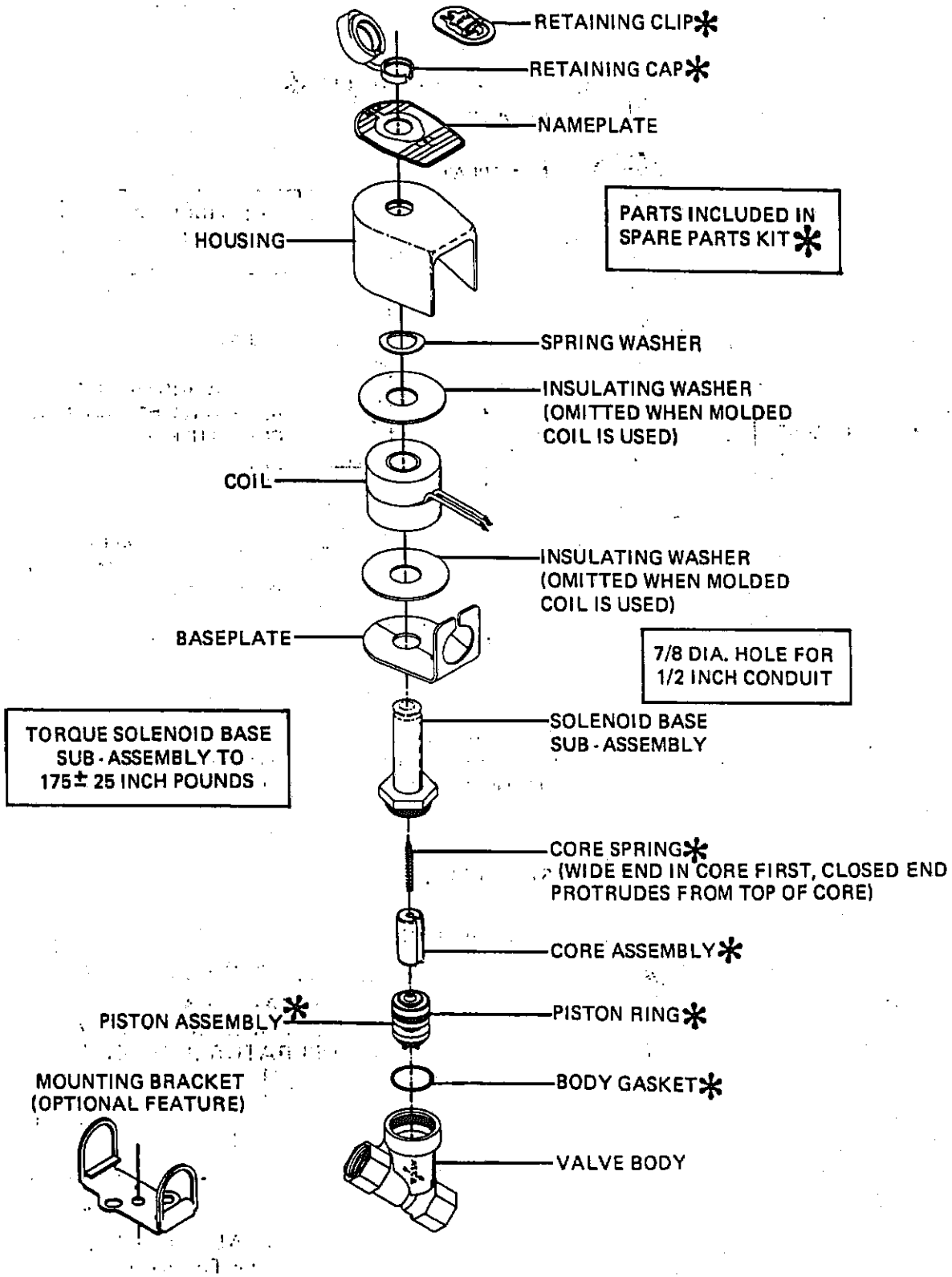


Figure 2. **Bulletin 8210 — A-C Construction**
General Purpose Solenoid Enclosure Shown.
For Explosion-Proof/Watertight Solenoid Enclosure used on Bulletin 8211, see Form No. V-5391.



Bulletin 8210 — D-C Construction
General Purpose Solenoid Enclosure Shown.
For Explosion-Proof/Watertight Solenoid Enclosure used on Bulletin 8211, see Form No. V-5380.

Figure 3.

ASCO Valves
Automatic Switch Co. FLORHAM PARK, NEW JERSEY 07932 Form No. V-5310R2 PRINTED IN U.S.A. 1976

HEPA FILTER HOUSING/FILTER SPECIAL INSTRUCTIONS

1. It is the installers responsibility to properly seal the PVC inlet and outlet transitions to the galvanized housing. Silicone caulk and mounting hardware has been supplied by Duall. It is essential that the transitions are sealed properly to insure that the filters are not fouled by outside contaminates or water.

2. Install the galvanized housing with the direction of flow stickers orientated properly.

3. You have been provide with filters with two different frames. The filters with galvanized frames are to be only installed in the bottom row of the galvanized housing. Install the filters with the direction of flow stickers orientated properly.

Should you have any further questions, please contact the factory or the manufacturer's local representative.

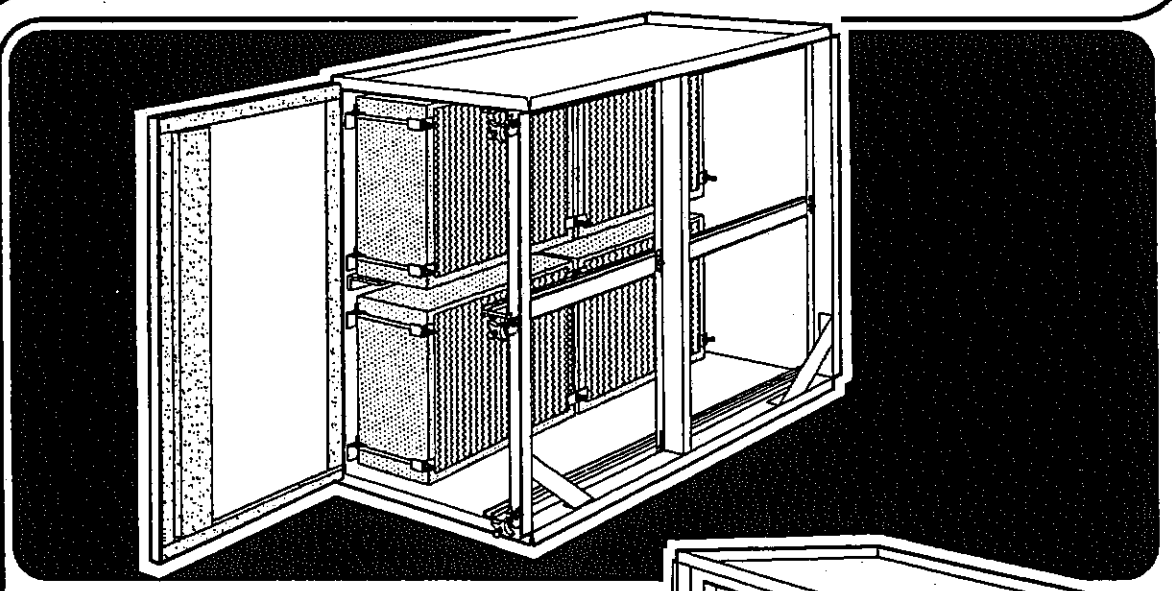
Met-Pro Corporation
Duall Division
1550 Industrial Drive
Owosso, Michigan 48867
phone: (517) 725-8184
fax: (517)725-8188
E-mail: dualldiv@shianet.org

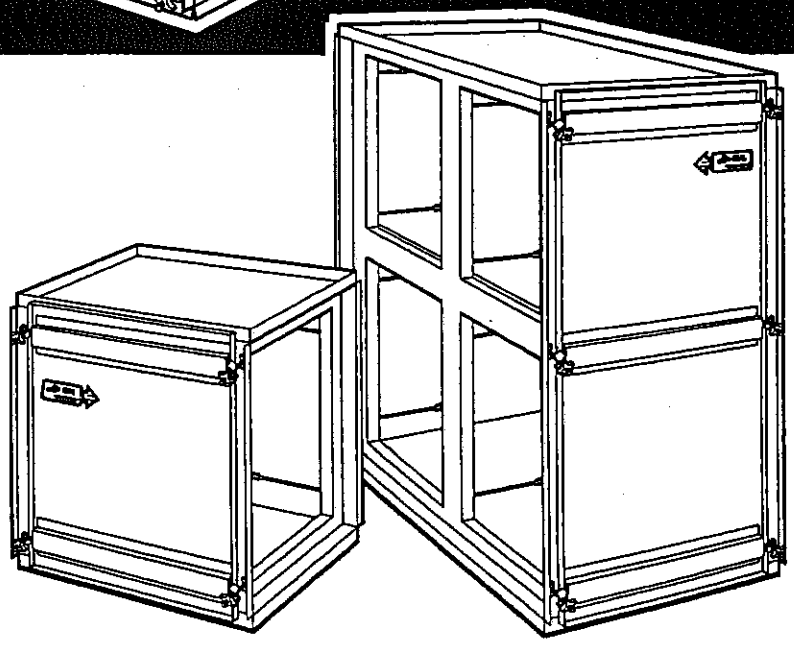
Air SEAL

SIDE ACCESS

BOLT-LOCK HEPA FILTER HOUSINGS

FOR THE COMMERCIAL/INDUSTRIAL FILTER INDUSTRY





Over eighteen years of exclusive fabrication of Filter Housings and Air Handlers

AIR SEAL SIDE ACCESS HEPA HOUSINGS . . . . WITH SWING ARM POSITIVE PRESSURE SPRING LOADED CLIP LOCKS

Air Seal Side Access Hepa Housings are designed and constructed to provide the highest possible degree of sealing integrity.

Each filter is individually sealed against the mounting frame. The mounting frame is constructed of structural tubing seam welded, ground, and polished. The frame is coated with a cold galvanized compound. Each filter is clamped against the frame with four swing arm assemblies.

CORNER GUSSETS MAKE AN EXTRA RIGID UNIT

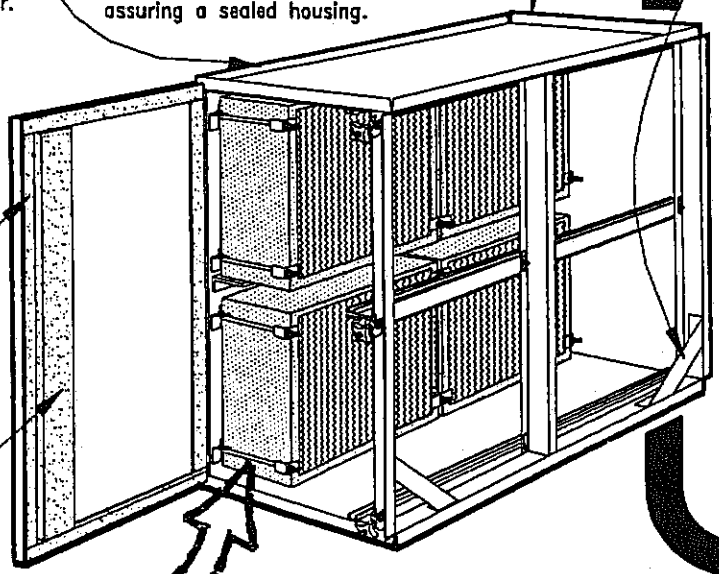
Corner gussets are standard on front of Air Seal housings . . . adding extra stability.

ALL METAL TO METAL COMPONENTS SEALED

After fabrication is complete, a silicone compound is applied to areas where metal meets metal, assuring a sealed housing.

1" FLANGES FOR EASY INSTALLATION

Turned out flanges all four sides both front and rear.



FILTER SEALING FRAME

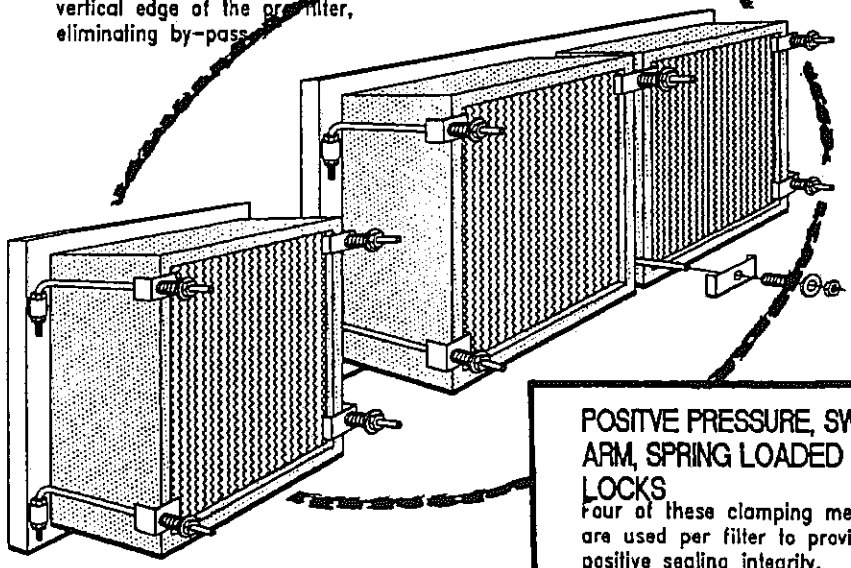
Each Hepa frame is constructed of seam welded structural steel tubing, ground, polished, and coated with a cold galvanizing compound. This provides a smooth surface for filters to seal against.

FULLY GASKETED ACCESS DOORS

Perimeter of doors are gasketed with closed cell neoprene gasketing assuring a complete seal when doors are closed.

COMPLETE GASKETING OF FILTERS

Urethane foam gasketing (two pound density) is installed on "inside of doors". When doors close, gasket seals against the vertical edge of the pre-filter, eliminating by-pass.



COMPLETE ONE-PIECE UNIT

The Air Seal Housing is factory assembled in a complete "one-piece" unit, constructed of 14 gauge galvanized steel.

EASY ACCESS FROM TWO SIDES

Access for filter installation is available from either side . . . or both.

POSITIVE PRESSURE, SWING ARM, SPRING LOADED CLIP LOCKS

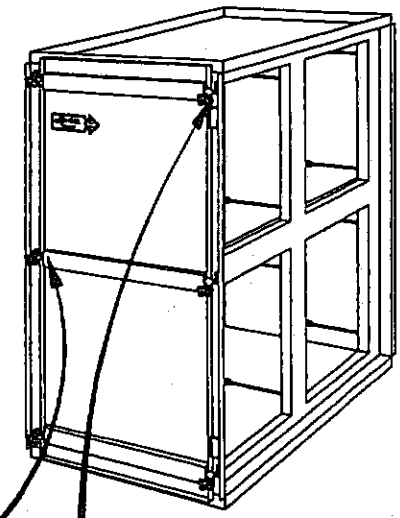
Four of these clamping mechanisms are used per filter to provide positive sealing integrity.

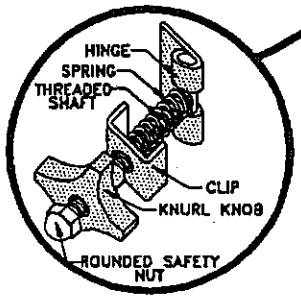
Air SEAL'S COMPRESSION-TIGHT BOLT-DOWN DOORS

WITH SLIP HINGES THAT KEEP DOORS IN PLACE

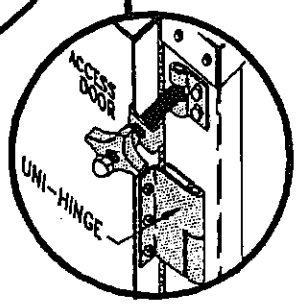
Air Seal's special latching system offers the convenience of "hinged doors" with the sealing integrity of "bolt-down" doors.

Positive pressure swing away knurl-knob latches locks the door tight on both sides. Yet, when door is open for servicing, the hinge action keeps it in place.





POSITIVE PRESSURE KNURL-KNOB



UNI-HINGE WITH KNURL-KNOB

THE PRIDE AND SKILL OF CRAFTSMANSHIP BUILT INTO EVERY AIR SEAL HOUSING ASSURES CUSTOMER SATISFACTION

PROBLEMS ARE ELIMINATED WITH AIR SEAL

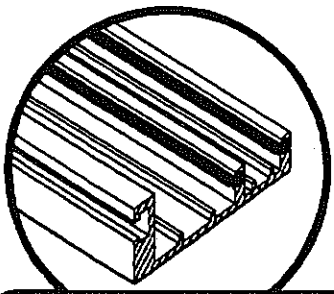
Air Seal's design is simple . . .
It's rugged, and it's ready to install.
the factory assembled housing is delivered in a complete one piece unit. There's no time consuming problems of field installation . . . modular sections . . . or add-on sections.

INSTALLATION IS SIMPLIFIED WITH AIR SEAL

Outward turned one-inch flanges facilitate the installation of the Air Seal Housing to the duct and / or air handling system.

ADD ANY OF THESE OPTIONAL FEATURES

- FLUID SEAL FRAMING SYSTEM
- WEATHERPROOF CONSTRUCTION
- EPOXY COATINGS
- HIGH TEMPERATURE HOUSINGS
- DOUBLE WALL INSULATED HOUSINGS
- MULTI-STAGE HEPA HOUSINGS
- SUPPLY FAN UNITS WITH HEPA FILTRATION
- HIGH PRESSURE CONSTRUCTION



EXTRUDED ALUMINUM FILTER TRACKS

Prefilter tracks are extruded aluminum combined with reinforced nylon pile seal to create a corrosion resistant seal.

DIMENSIONS OF AIR SEAL HEPA HOUSINGS

Listed are the "OUTSIDE DIMENSIONS" of each housing. They include a one-inch turned out flange. Dimensions are based on using full size 24" x 24" face size filters.

High		Wide	
½	14 ½"	½	16"
1	26 ½"	1	28"
1 ½	39"	1 ½	41"
2	51"	2	53"
2 ½	63 ½"	2 ½	66"
3	75 ½"	3	78"
3 ½	88"	3 ½	91"
4	100"	4	103"
		4 ½	116"
		5	128"
		5 ½	141"
		6	153"

WEATHERPROOF HOUSINGS ARE 1" TALLER AND 2" NARROWER THAN STANDARD HOUSINGS.

FOR HEPA FILTERS SIZE 24" X 30"
HOUSING SIZE 1 X 1
HOUSING HEIGHT - 28.5"
HOUSING WIDTH = 34"

HOUSINGS DEPTHS

Air Seal housings are available in four depths

Housings to accommodate 6" deep Hepa filter with NO pre-filter . . . . . .16" DEEP

Housings to accommodate 6" deep Hepa filter WITH pre-filter . . . . . 20" DEEP

Housings to accommodate 12" deep Hepa filter with NO pre-filter . . . . . .22.25" DEEP

Housings to accommodate 12" deep Hepa filter WITH pre-filter . . . . . .26.25" DEEP

COMPLETE SUBMITTALS AVAILABLE

Submittal drawings including Construction details are available on every catalogued Air Seal housing.

AIR SEAL FILTER HOUSINGS, INC.
1112 STAFFORDSHIRE RD.
STAFFORD, TEXAS. 77477

PHONE : (713) 499-9864
FAX : (713) 499-6060

FILTER SELECTION . . . AIR SEAL'S HEPA HOUSINGS ARE DESIGNED TO ACCOMMODATE THESE TYPE FILTERS . . .

PRE FILTERS

2" pleated filters, nominal face size 24" x 24" and 12" x 24"

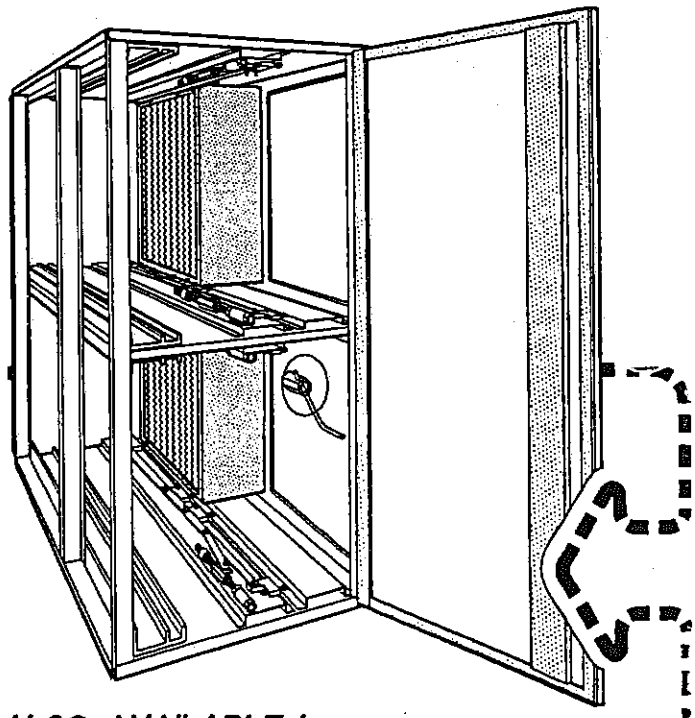
PRE FILTERS

4" pleated filters, nominal face size 24" x 24" and 12" x 24"

HEPA FILTERS

Actual 24" x 24" face size filters and actual 12" x 24" face size filters. Filters to be gasketed on air leaving side.

NOTE: Under-sized filters (23.38" x 23.38" face size) can be accommodated at a small additional cost. Contact Factory.



ALSO AVAILABLE !

AIR SEAL'S "CRANK-LOCK" SIDE ACCESS HEPA FILTER HOUSING

The Air Seal "Crank-Lock" Hepa Filter Housing is designed for sealing integrity and convenient "filter change" in a side access Hepa Filter Housing.

A cranking action activates the sealing mechanism. As the cranks turn, four spring loaded plungers press each filter (and gasket) against the mounting frame. Each spring exerts positive pressure on the filter frame keeping the gaskets compressed and the filters sealed.

The Air Seal Hepa Housing is factory assembled in a complete "one piece" unit of 14 gauge galvanized steel. (Also available in stainless steel)

CONTACT AIR SEAL FOR BROCHURES AND FACTORY DATA ON "CRANK-LOCK" HEPA HOUSINGS.

☐ APPROVED PER
☐ APP[illegible] NOTED
☐ CORRECT [illegible] RE-SUBMIT

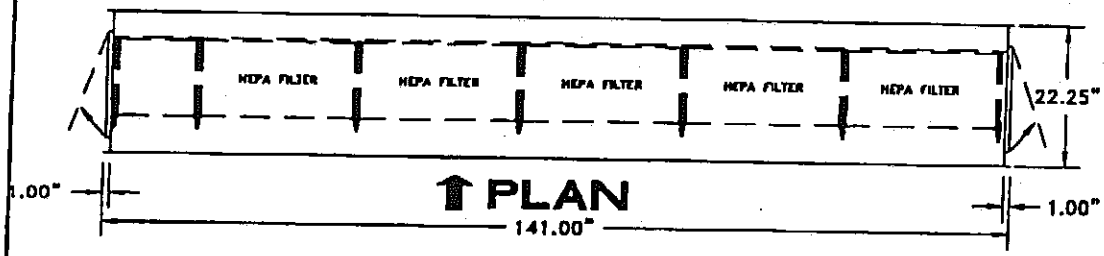
Air SEAL

SIDE ACCESS HEPA FILTER HOUSING

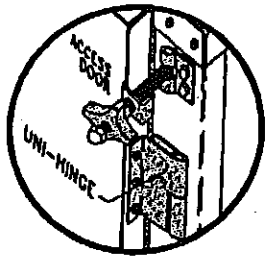
BOLT LOCK ASSEMBLY

HIGH PRESSURE CONSTRUCTION

MODEL No. HBD-40-55-HP-EP



PLAN



UNI-HINGE WITH KNURL-KNOB

NOTES

12 GAUGE GALVANIZED STEEL CONSTRUCTION.

DOORS SEALED WITH CLOSED CELL NEOPRENE GASKETING.

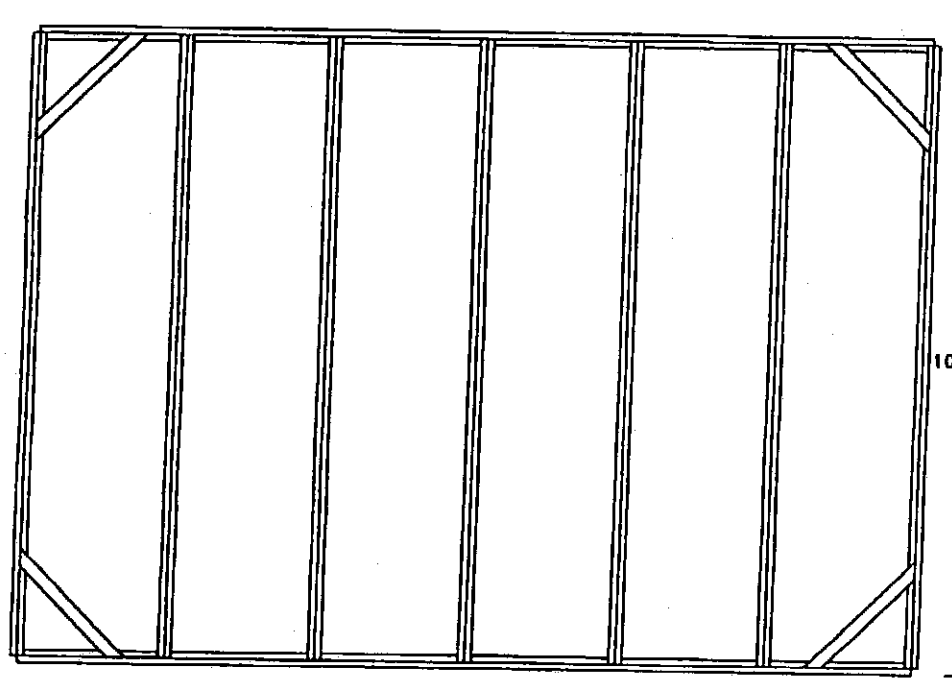
METAL TO METAL COMPONENTS SEALED WITH SILICONE COMPOUND.

DOORS FITTED WITH KNURL KNOB – BOLT DOWN LATCHES WITH UNI-HINGES.

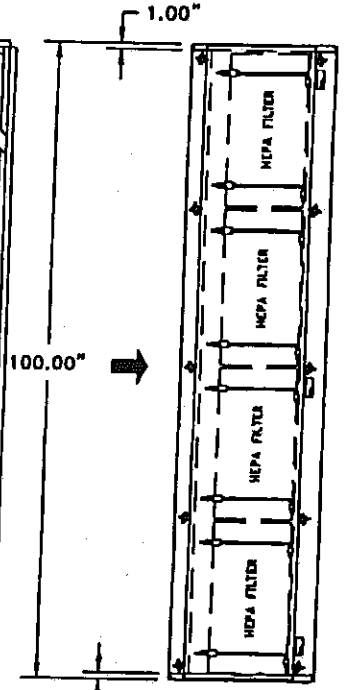
HIGH PRESSURE UP TO 10" POSITIVE PRESSURE

EPOXY COATING – INTERIOR & EXTERIOR. (GRAY)

SEAM WELDED – EXTERIOR ONLY.



FRONT



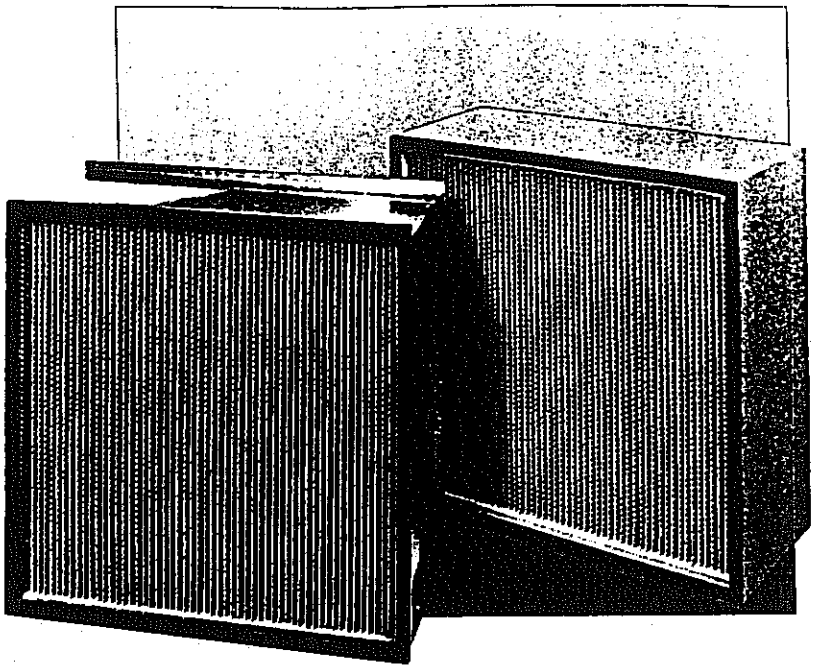
SIDE

FILTER SCHEDULE

	NUMBER OF 12" FILTERS REQUIRED.	
	FACE SIZE FILTERS	
	NOMINAL SIZE:	12" X 12" X 12"
	ACTUAL SIZE:	12" X 12" X 12"
4	NOMINAL SIZE:	12" X 24" X 12"
	ACTUAL SIZE:	12" X 24" X 12"
20	NOMINAL SIZE:	24" X 24" X 12"
	ACTUAL SIZE:	24" X 24" X 12"
TYPE OF FILTER:		

Flanders® / Air SEAL STAFFORD, TEXAS.

PROJECT:		UNIT TAG:	DATE: 9/8/97
PURCHASER:	SIZE: 4 X 5-1/2	DESIGNED BY: LUIS HERNANDEZ	P.O. #:
ENGINEER:	QUANTITY:	REPRESENTATIVE: FACT	DRAWING NAME: HBD-452-HP



AstroCel® I

High Efficiency Particulate Air Filters (HEPA)

Ultra Low Penetration Air Filters (ULPA)

FACT INC.

FILTER AND COATING TECHNOLOGY

SHIPPING ADDRESS: 5706 WEST RIVER DRIVE
BELMONT, MI 49306

MAILING ADDRESS: P.O. BOX 2287
GRAND RAPIDS, MI 49501

TELEPHONE (616) 784-3228
WATS 800 632-9573
FAX (616) 784-2015

AAF INTERNATIONAL

AAF AstroCel® I

The Industry's Widest Selection of HEPA and ULPA Filters

HEPA and ULPA filters are the most efficient air filters commercially available. Originally developed for the Atomic Energy Commission, today they have broad application in Cleanrooms and other areas requiring the very highest levels of contamination control:

- Semiconductor
- Electronics
- Pharmaceutical
- Nuclear Power Stations
- Department of Defense
- Department of Energy
- Photo Film
- Hospitals
- Laboratories
- Food Processing
- Asbestos Abatement

The AAF family of AmericanAirFilter HEPA and ULPA filter products features a broader selection of efficiencies, cell side materials and configurations, separator designs and bonds than any other manufacturer. AAF can also provide a complete selection of high integrity framing systems, ceiling grids, replaceable cartridge and permanent ceiling modules (hoods), side access housings and Bag In/Bag Out units.

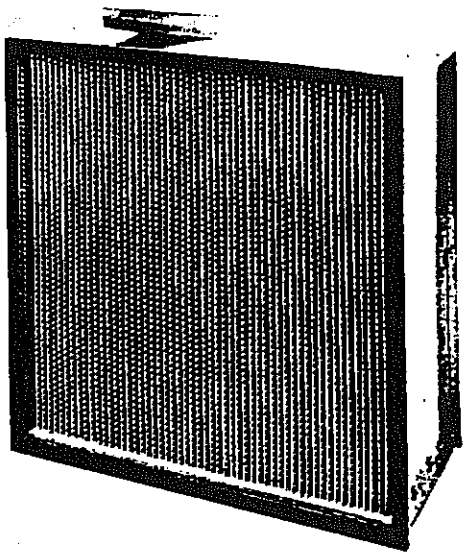
Standard Capacity

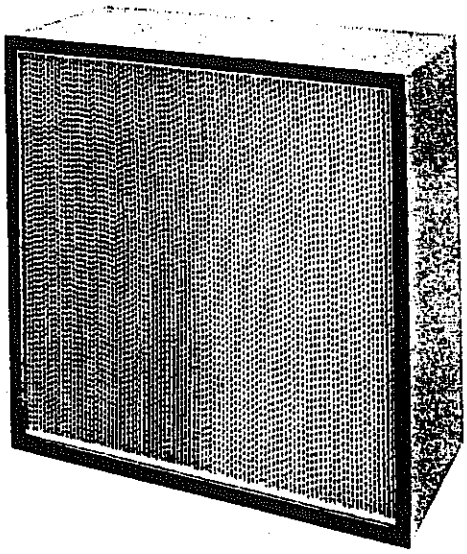
5⅞" deep - 150 FPM @ 1.0" W.G.

11½" deep - 260 FPM @ 1.0" W.G.

HEPA Efficiencies - 99.97% and 99.99% minimum efficiency on 0.3 micrometer particles.

ULPA Efficiency - 99.999% minimum efficiency on 0.3 micrometer particles and 99.9995% on 0.1 to 0.2 micrometer particles (11½" deep only). For ULPA, MEGA and GIGA efficiencies up to 99.999995% on .10 to .20 micrometer particles, use AstroCel II LPD Series minipleat filters.





High Capacity

11½" deep - 500 FPM @ 1.4" W.G.

HEPA Efficiencies - 99.97% and 99.99% minimum efficiency on 0.3 micrometer particles.

AstroCel filters are available to meet all Performance Classes per the Institute of Environmental Sciences IES RP-1:

Type A — Minimum efficiency of 99.97% on 0.3 µm at rated flow.

Type B — Minimum efficiency of 99.97% on 0.3 µm at 100% and 20% of rated flow.

Type C — Minimum efficiency of 99.97% on 0.3 µm and scan tested.

Type D — Minimum efficiency of 99.999% on 0.3 µm and scan tested.

Type E — Constructed and tested in accordance with MIL-F-51477 or MIL-F-51068.

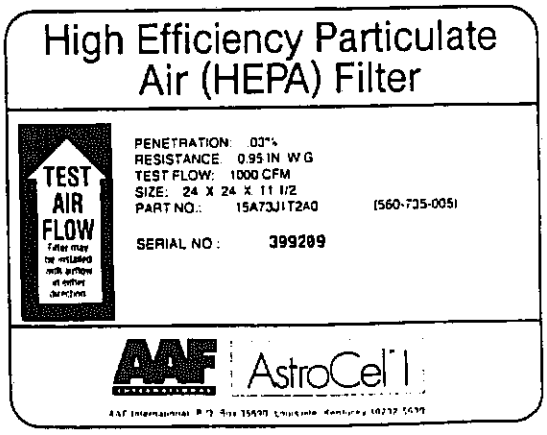
Type F — Minimum efficiency of 99.999% on 0.1 to 0.2 µm and scan tested.

Guaranteed Performance

Every AstroCel filter is individually tested before it leaves the factory — your assurance that it meets rated efficiency. The penetration and actual resistance at test airflow rate are indicated on the label. Each filter is also assigned a serial number and a permanent record is kept of the materials of construction and performance.

Test results on each filter are indicated on the label.

Selected nuclear grade AstroCel filters have been qualified by the Department of the Army for the Qualified Products List (QPL) for use in critical applications such as the Department of Energy and nuclear power plants. To qualify for the QPL, the filters are subjected to a series of rigorous environmental conditions and still meet rated efficiency. Very few manufacturers' HEPA filters are QPL qualified.

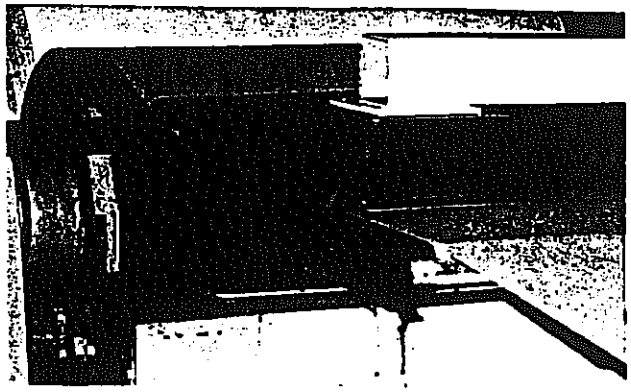


Manufactured to the Highest Quality Standards

Media Testing To Meet Exacting Quality Standards

Every roll of media is carefully checked for a specific set of physical and performance characteristics, including:

- Efficiency
- Resistance
- Thickness
- Weight
- Tensile Strength
- Binder Content
- Water Repellency

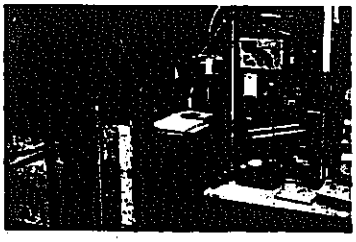


All media is checked continuously and automatically for weight.

Overall Efficiency Testing

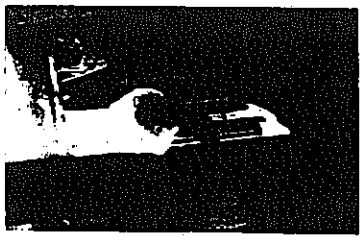
Two methods of overall efficiency testing are used:

DOP Test — This has been the industry standard test method for many years. It is conducted in accordance with the U.S. Army Edgewood Arsenal Instruction Manual 136-300-175 using a Q-127 penetrometer (forward light scattering photometer). The filter is challenged with monodispersed 0.3 micrometer particles of dioctylphthlate (DOP). By measuring the upstream and downstream concentration of these particles, the filter efficiency can be calculated.



AAF DOP Test Facility.

Laser Test — The filter is tested with a laser spectrometer using ambient air as the challenge particulate. Filter efficiency is determined by comparing the upstream and downstream concentration of particles 0.10 to 3.0 micrometers in size.



AAF Laser Spectrometer.

Scan Testing

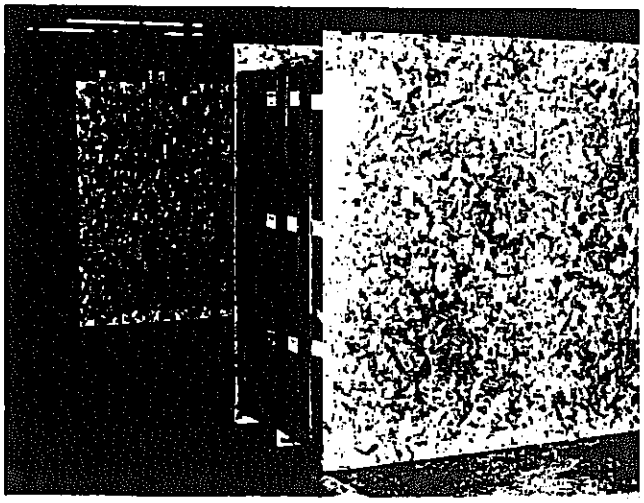
Leak Testing — AstroCel filters can be factory scanned to assure there are no pinhole leaks. Filters that pass the overall test may still have minute pinhole leaks. Scanning detects these leaks, which are repaired before the filter is released for shipment.

AAF uses a proprietary static scan test with a challenge aerosol of nontoxic, polyfunctional alcohol which leaves no residue on the media.

Scan test showing leak indicated by a smoke trail.

Palletized Shipments Prevent Damage

AstroCel filters are palletized and stretchwrapped for reliable protection during shipment. Additional facing protection or fully enclosed crating is available when required.



Palletized shipments prevent damage in transit.

Underwriters' Laboratories Classifications

U.L. Class 1 – AstroCel I filters are classified U.L. Class 1 by Standard 900 (except those made with non fire retardant wood cell sides).

U.L. 586 - AstroCel I filters are classified according to U.L. Standard 586. This is an extremely rigorous test that subjects the filters to:

- High Moisture Conditions (90% R.H.)
- High Temperature (700°F/371°C)
- Spot Flame (1750°F/954°C)
- Low Temperature (27°F/-3°C)

A numbered U.L. label certifying that the filter meets Standard 586 can be applied to the filter (maximum size 24" x 30").

AstroCel I Selection

AstroCel I filters are available in a wide variety of standard sizes and construction materials. Special sizes can be fabricated or special materials used for highly specialized requirements.

There are twelve different criteria encompassing materials and performance that go into the make up of an AstroCel filter. Careful selection of the right combination will result in the filter that best meets the needs of your application.

Size

40 standard sizes from 8" x 8" to 36" x 72".
(See table on next page.)

AstroCel sizes are listed with the height dimension first, followed by the width, then depth.

Minimum Efficiency

99.97% - .3 µm (HEPA)
99.99% - .3 µm (HEPA)
99.999% - .3 µm (ULPA)
99.9995% - .10 to .20 µm (ULPA)

Scan Tested (Optional)

AstroCel I filters can be scan tested to eliminate pinhole leaks.

Media

Waterproof, fire retardant fiberglass.

Waterproof, fire retardant, radiation resistant fiberglass.

Cell Side Material

Plywood
Fire Retardant Plywood
Particle Board
Fire Retardant Particle Board
Galvanized Steel
Stainless Steel
Aluminum

For Bottom Row Of Filters Only

Separators

Aluminum
Vinyl Coated Aluminum

Bond

Polyurethane Foam
White Polyurethane Elastomer
Silicone
Black Cement

Gasket

Neoprene Expanded Rubber
Silicone

Gasket Location

None
One Side
Both Sides

Faceguards (Optional)

4 x 4 Mesh Hardware Cloth
Galvanized Steel
Stainless Steel

Faceguard Location

None
One Side
Both Sides

U.L. 586 Classified (Optional)

Numbered U.L. certification label to be applied. (Limited to sizes no larger than 24" x 30".)

Operating Data

Metric Conversion Table
1.0 in. = 2.54 cm
1 CFM = 1.70 m^3/hr
1.0 in. W.G. = 249 Pa

Standard Sizes

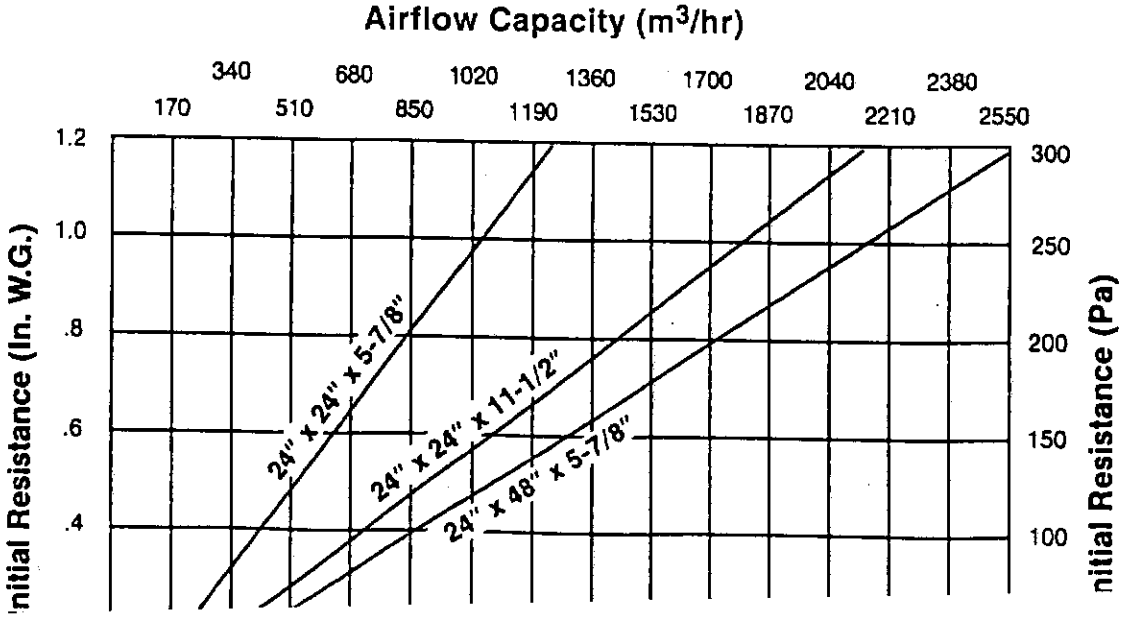
Actual Filter Size (Inches) (H x W x D)	Rated Airflow Capacity (SCFM) (@ 1.0" W.G.)
8 x 8 x 5-7/8	55
12 x 12 x 5-7/8	150
12 x 24 x 5-7/8	300
15-3/8 x 19-3/8 x 5-7/8	275
20-7/8 x 20-7/8 x 5-7/8	440
20-7/8 x 44-7/8 x 5-7/8	960
23-1/4 x 23-1/4 x 5-7/8	550
23-1/4 x 29-1/4 x 5-7/8	700
23-1/4 x 35-1/4 x 5-7/8	850
23-1/4 x 41-1/4 x 5-7/8	1000
23-1/4 x 47-1/4 x 5-7/8	1125
23-3/8 x 23-3/8 x 5-7/8	570
24 x 12 x 5-7/8	300
24 x 24 x 5-7/8	600
24 x 30 x 5-7/8	750
24 x 36 x 5-7/8	900
24 x 48 x 5-7/8	1230

Actual Filter Size (Inches) (H x W x D)	Rated Airflow Capacity (SCFM) (@ 1.0" W.G.)
24 x 60 x 5-7/8	1550
24 x 72 x 5-7/8	1900
30 x 24 x 5-7/8	750
30 x 30 x 5-7/8	925
30 x 36 x 5-7/8	1150
30 x 48 x 5-7/8	1550
30 x 60 x 5-7/8	1975
30 x 72 x 5-7/8	2350
36 x 24 x 5-7/8	900
36 x 30 x 5-7/8	1150
36 x 36 x 5-7/8	1400
36 x 48 x 5-7/8	1900
36 x 60 x 5-7/8	2350
36 x 72 x 5-7/8	2850

Actual Filter Size (Inches) (H x W x D)	Rated Airflow Capacity (SCFM) (@ 1.0" W.G.)
12 x 12 x 11-1/2	225
12 x 24 x 11-1/2	500
15-3/8 x 19-3/8 x 11-1/2	525
20-7/8 x 20-7/8 x 11-1/2	775
23-3/8 x 23-3/8 x 11-1/2	1000
24 x 12 x 11-1/2	500
24 x 24 x 11-1/2	1050
24 x 30 x 11-1/2	1350
24-3/8 x 19-3/8 x 11-1/2	850

NOTES:
1. Dimensions do not include gaskets.
2. Width dimensions over 48" are furnished with a center divider.
3. The "H" (height) dimension indicates the direction of the separators. AstroCel filters should always be installed with the separators vertical.
4. Many sizes are available with test ports and a center divider.
5. AstroCel I filters are non-directional and may be installed with the airflow in either direction. The arrow on the label indicates the direction of airflow during factory testing.

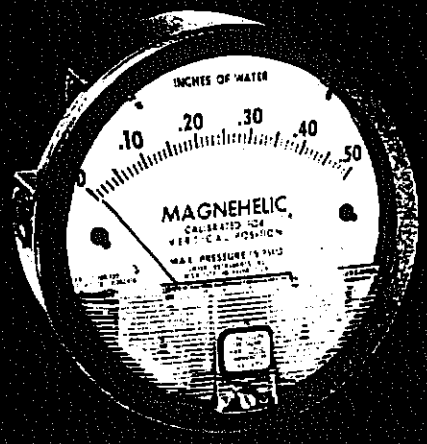
Initial Resistance vs. Airflow Capacity



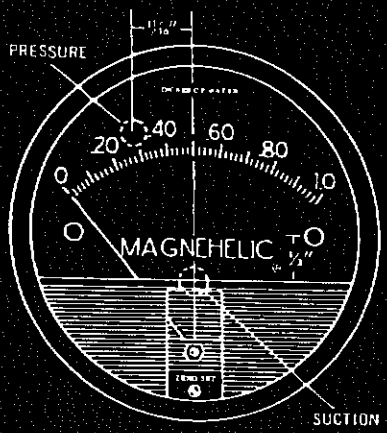
Dwyer

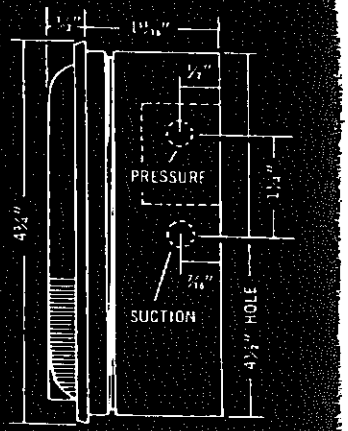
SERIES 2000

Magnehelic® Differential Pressure Gages



Standard Magnehelic® Pressure Gage has a large, easy-to-read 4" dial.

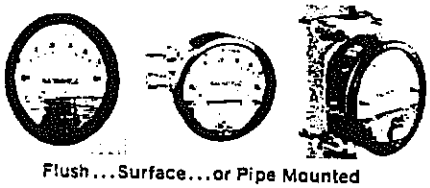




Dimensions, Standard Series 2000 Magnehelic® Pressure Gages. (Slightly different on medium and high pressure models)

Select the Dwyer Magnehelic® gage for high accuracy – guaranteed within 2% of full scale – and for the wide choice of 81 ranges available to suit your needs precisely. Using Dwyer's simple, frictionless Magnehelic® movement, it quickly indicates low air or non-corrosive gas pressures – either positive, negative (vacuum) or differential. The design resists shock, vibration and over-pressures. No manometer fluid to evaporate, freeze or cause toxic or leveling problems. It's inexpensive, too.

Widely used to measure fan and blower pressures, filter resistance, air velocity, furnace draft, pressure drop across orifice plates, liquid levels with bubbler systems and pressures in fluid amplifier or fluidic systems. It also checks gas-air ratio controls and automatic valves, and monitors blood and respiratory pressures in medical care equipment.



Flush...Surface...or Pipe Mounted

Mounting. A single case size is used for most ranges of Magnehelic gages. They can be flush or surface mounted with standard hardware supplied. With the optional A-610 Pipe Mounting Kit they may be conveniently installed on horizontal or vertical 1¼"-2" pipe. Although calibrated for vertical position, many ranges above 1 inch may be used at any angle by simply re-zeroing. However, for maximum accuracy, they must be calibrated in the same position in which they are used. These characteristics make Magnehelic gages ideal for both stationary and portable applications. A 4½" hole is required for flush panel mounting. Complete mounting and connection fittings plus instructions are furnished with each instrument.

Vent valves

In applications where pressure is continuous and the Magnehelic gage is connected by metal or plastic tubing which cannot be easily removed, we suggest using Dwyer A-310A vent valves to connect gage. Pressure can then be removed to check or re-zero the gage.

HIGH AND MEDIUM PRESSURE MODELS

Installation is similar to standard gages except that a 4¾" hole is needed for flush mounting. The medium pressure construction is rated for internal pressures up to 35 psig and the high pressure up to 80 psig. Available in all ranges. Because of larger case, will not fit in portable case. Weight 1 lb., 10 oz. (Installation of the A-321 safety relief valve on standard Magnehelic gages often provides adequate protection against infrequent overpressure; see Bulletin S-101).

PHYSICAL DATA

Ambient temperature range: 20° to 140°F.*

Rated total pressure: –20" Hg. to 15 psig.†

Connections: ⅛" NPT high and low pressure taps, duplicated – one pair side and one pair on back.

Housing: Die cast aluminum. Case and aluminum parts Iridite-dipped to withstand 168 hour salt spray test. Exterior finish is baked dark gray hammerloid.

Standard ranges: See facing page.

Accuracy: Plus or minus 2% of full scale (3% on –0 and 4% on –00 ranges), throughout range at 70°F.

Standard accessories: Two ⅛" NPT plugs for duplicate pressure taps, two ⅛" pipe thread to rubber tubing adapters, and three flush mounting adapters with screws. (Mounting ring and snap ring retainer substituted for 3 adapters in MP & HP gage accessories.)

Weight: 1 lb. 2 oz.

*Low temperature models available as special option.
†For applications with high cycle rate within gage total pressure rating, next higher rating is recommended. See Medium and High pressure options at lower left.

OPTIONS AND ACCESSORIES

Transparent overlays

Furnished in red and green to highlight and emphasize critical pressures.

Adjustable signal flag

Integral with plastic gage cover; has external reset screw. Available for all ranges (not high pressure). Can be ordered with gage or separately.

Portable units

Combine carrying case with any Magnehelic gage of standard range (not high pressure). Includes 9 ft. of ¼" I.D. rubber tubing, stand-hang bracket, and terminal tube with holder.

Air filter gage accessory package

Adapts any standard Magnehelic for use as an air filter gage. Includes aluminum surface-mounting bracket with screws, two 5 ft. lengths of ¼" aluminum tubing, two static pressure tips and two molded plastic vent valves, integral compression fittings on both tips and valves.

Quality design and construction features

...l provides flange for flush mount-...g in panel.

Clear plastic face is highly resistant to breakage. Provides undistorted viewing of pointer and scale.

Precision litho-printed scale is accurate and easy to read.

Red tipped pointer of heat treated aluminum tubing is easy to see. It is rigidly mounted on helix shaft.

Pointer stops of molded rubber prevent pointer over-travel without damage.

Sapphire bearings are shock-resistant mounted; provide virtually friction-free motion for helix. Motion damped with high viscosity silicone fluid.

Zero adjustment screw is conveniently located in plastic cover, accessible without removing cover. "0" ring seal provides pressure tightness.

"0" ring seal for cover assures pressure integrity of case.

Die cast aluminum case is precision made. Iridite-dipped to withstand 168 hour salt spray test. Exterior finished in baked dark gray hammerloid. One case size used for all standard pressure ranges, and for both surface and flush mounting.

Silicone rubber diaphragm with integrally molded "0" ring is supported by front and rear plates. It is locked and sealed in position with a sealing plate and retaining ring. Diaphragm motion is restricted to prevent damage due to overpressures.

Calibrated range spring is a flat leaf of Swedish spring steel in temperature compensated design. Small amplitude of motion assures consistency and long life. It reacts to pressure on diaphragm. Live length adjustable for calibration.

"Wishbone" assembly provides mounting for helix, helix bearings and pointer shaft.

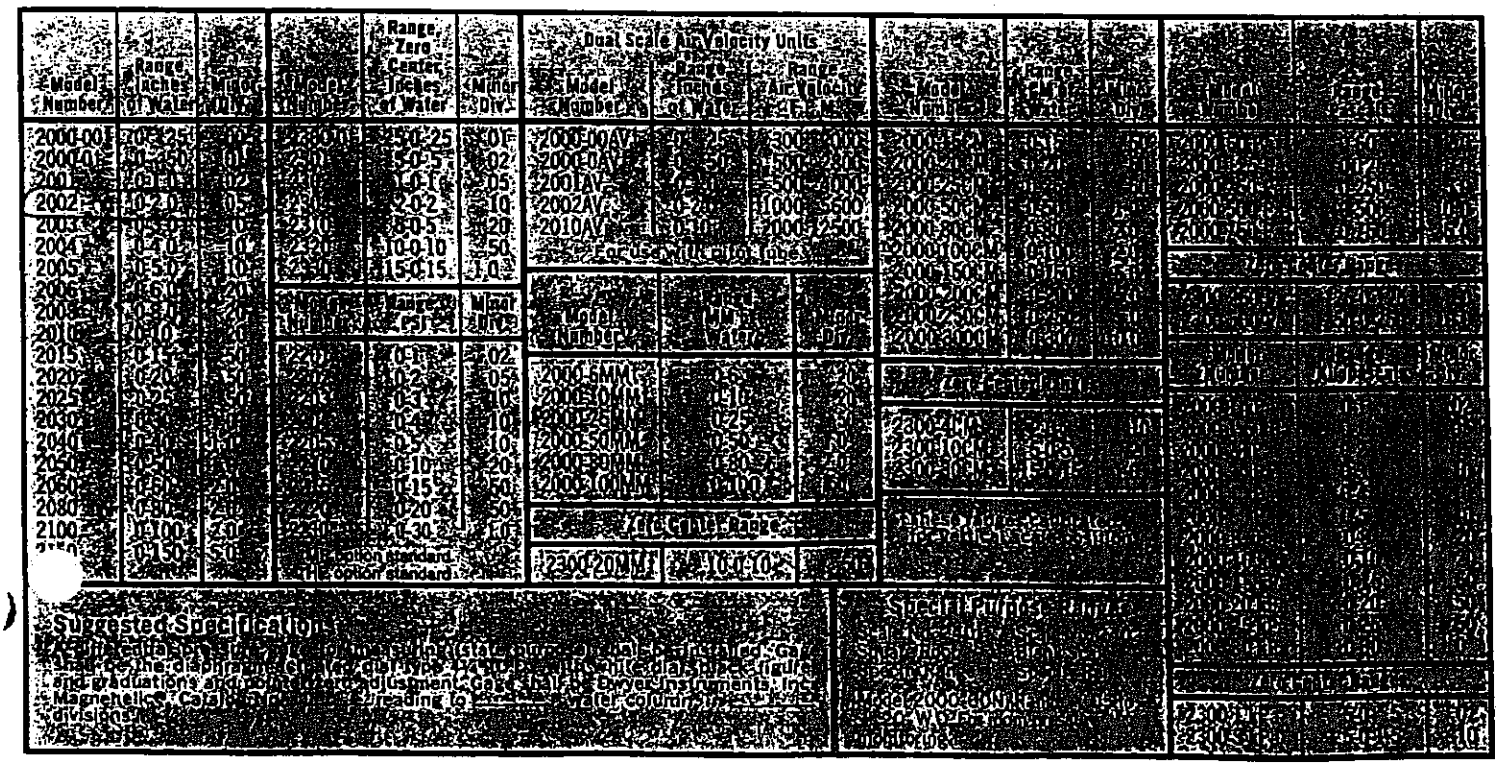
Samarium cobalt magnet mounted at end of range spring rotates helix without mechanical linkages.

Helix is precision milled from an alloy of high magnetic permeability, deburred and annealed in a hydrogen atmosphere for best magnetic qualities. Mounted in jeweled bearings, it turns freely to align with magnetic field of magnet to transmit pressure indication to pointer.

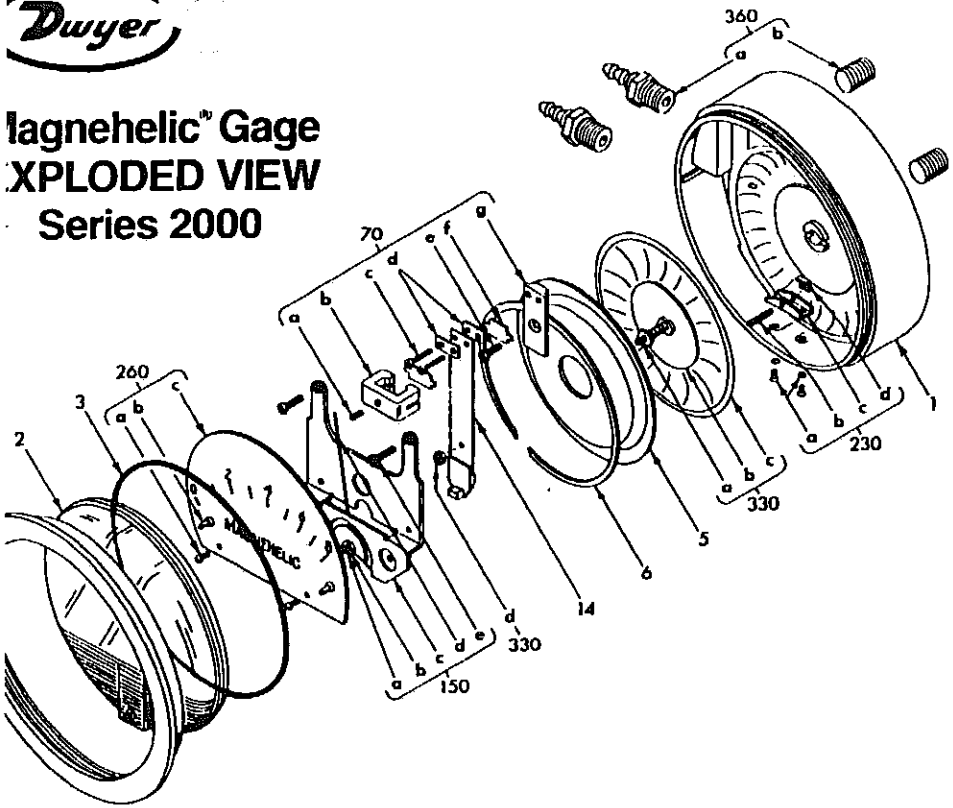
SERIES 2000 MAGNEHELIC® — MODELS AND RANGES

2002

The models below will fulfill most requirements. Page 5 also shows examples of special models built for OEM customers. For special scales furnished in ounces per square inch, inches of mercury, metric units, etc., contact the factory.



Magnehelic® Gage EXPLODED VIEW Series 2000



1. Case
2. Cover with zero adjust assy.
3. "O" ring seal
4. Bezel
5. Diaphragm sealing plate
6. Retaining ring
70. Range Spring assembly
    a. Clamp set screw
    b. Clamp
    c. Mounting screws (2 req'd)
    d. Clamping shoe (2 req'd)
    e. Clamp plate screw
    f. Spacer (2 req'd)
    g. Clamp plate
*14. Range Spring with magnet
150. Wishbone Assembly – consists of:
    a. Front jewel
    b. Locking nut
    c. Wishbone
    d. Pointer
    e. Mounting screws (2 req'd)
    f. Helix assembly (not shown)
    g. Pivots (2 req'd) (not shown)
    h. Rear jewel (not shown)

230. Zero adjust assembly – consists of:
    a. Foot screws with washers (2 req'd)
    b. Adjust screw
    c. Foot
    d. Finger
*260. Scale Assembly – consists of:
    a. Mounting screws (2 req'd)
    b. Bumper pointer stop (2 req'd)
    c. Scale
*330. Diaphragm Assembly – consists of:
    (Arbor press needed to install)
    a. Linkage assy., complete
    b. Front plate
    c. Diaphragm
    d. Rear plate (not shown)
    e. Plate washer (not shown)
360. Mounting Hardware Kit
    a. Adapter – pipe plug ⅛" NPT to rubber tubing – (2 req'd)
    b. Pipe plug ⅛" NPT – (2 req'd)
    c. Mounting lug (3 req'd)
    d. Long screw (3 req'd)
    e. Short screw (3 req'd)
    f. Stud (solid)
    g. Stud washer
    h. Stud nut
    i. Stud (hollow)

Ordering Instructions:

When corresponding with the factory regarding Magnehelic® gage problems, refer to the call-out numbers in this view. Be sure to include model number, pressure range, and any special options. Field repair is not recommended; contact the factory for repair service information.

Litho in U.S.A. 3-85

12-440212-00

OPERATING INSTRUCTIONS and PA' 1 LIST

Magnehelic® Differential Pressu Gage

SPECIFICATIONS

Dimensions: 4-3/4" dia. X 2-3/16" deep.

Weight: 1 lb. 2 oz.

Finish: Baked dark gray enamel.

Connections: 1/8 N.P.T. high and low pressure taps, duplicated, one pair side and one pair back.

Accuracy: Plus or minus 2% of full scale, at 70°F (Model 2000-0, 3¼; 2000-00, 4%).

Pressure Rating: 15 PSI.

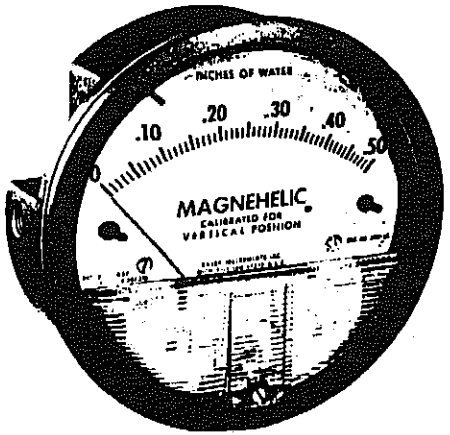
Ambient Temperature Range: 20° to 140°F.

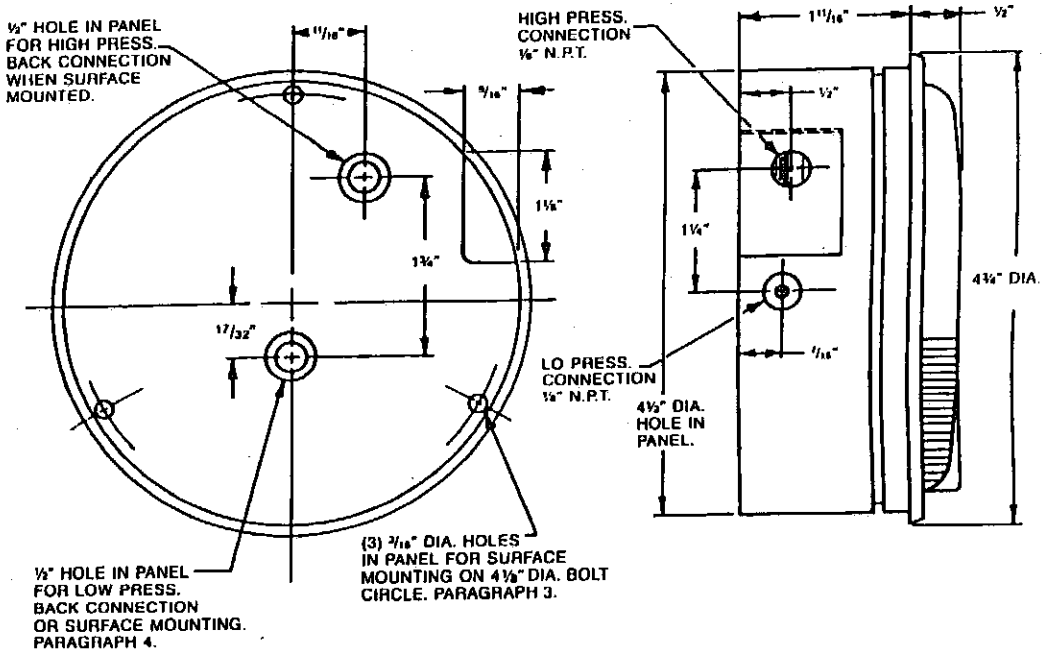
Standard gage accessories include two 1/8" N.P.T. plugs for duplicate pressure taps, two 1/8" pipe thread to rubber tubing adapters, back mounting stud with two washers and jam nut and three flush mounting adapters with screws.

Caution: For use with air or compatible gases only.

For repeated over-ranging or high cycle rates, contact factory.

Hydrogen Gas Precautionary Note: The rectangular rare earth magnet used in the standard gage may not be suitable for use with hydrogen gas since a toxic and explosive gas may form. For hydrogen service, consult the factory for an alternate gage construction.





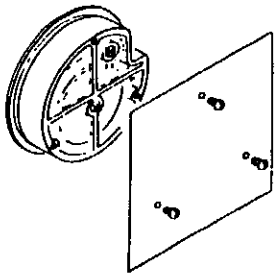
DWYER INSTRUMENTS, INC.
P. O. BOX 373 • MICHIGAN CITY, INDIANA 46360, U.S.A.
Telephone 219/872-9141

MAGNEHELIC INSTALLATION

. Select a location free from excessive bration and where the ambient temperature ill not exceed 140°F. Also, avoid direct nlight which accelerates discoloration of e clear plastic cover. Sensing lines may be n any necessary distance. Long tubing ngths will not affect accuracy but will crease response time slightly. Do not restrict nes. If pulsating pressures or vibration cause cessive pointer oscillation, consult the fac- ry for ways to provide additional damping.

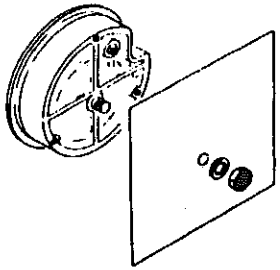
. All standard Magnehelic gages are cali- ated with the diaphragm vertical and ould be used in that position for maximum curacy. If gages are to be used in other than rtical position, this should be specified on e order. Many higher range gages will per- rm within tolerance in other positions with dy rezeroing. Low range Model 2000-00 d metric equivalents must be used in the rtical position only.

. Surface Mounting



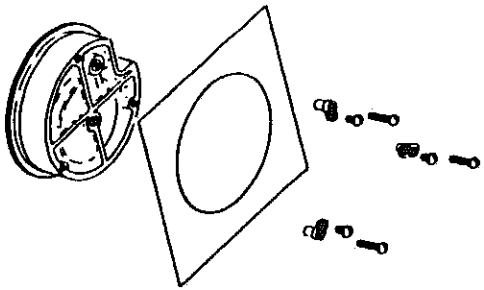
ocate mounting holes, 120° apart on a 4-1/8" a. circle. Use No. 6-32 machine screws of opropriate length.

. Single Stud Surface Mounting



ocate mounting hole. Use double ended 1/8" hread stud. Part No. 360-f, securely inserted n center low pressure opening. Mount hrough a bulkhead with washer and jam nuts s in sketch. As an alternate, mount the gage with the stud using a 1/8" pipe thread flange or other 1/8" pipe thread opening.

5. Flush Mounting



Provide a 4½" dia. opening in panel. Insert gage and secure in place with No. 6-32 machine screws of appropriate length, with adaptors, Part No. 360c, firmly secured in place. To mount gage on 1¼"-2" pipe, order optional A-610 pipe mounting kit.

6. To zero the gage after installation

Set the indicating pointer exactly on the zero mark, using the external zero adjust screw on the cover at the bottom. Note that the zero check or adjustment can only be made with the high and low pressure taps both open to atmosphere.

Operation

Positive Pressure: Connect tubing from source of pressure to either of the two high pressure ports. Plug the port not used. Vent one or both low pressure ports to atmosphere.

Negative Pressure: Connect tubing from source of vacuum or negative pressure to either of the two low pressure ports. Plug the port not used. Vent one or both high pressure ports to atmosphere.

Differential Pressure: Connect tubing from the greater of two pressure sources to either high pressure port and the lower to either low pressure port. Plug both unused ports.

When one side of gage is vented in a dirty, dusty atmosphere, we suggest an A-331 Filter Vent Plug be installed in the open port to keep inside of gage clean.

a. For portable use or temporary installation, use 1/8" pipe thread to rubber tubing adapter and connect to source of pressure with rubber or Tygon tubing.

b. For permanent installation, 1/4" O.D., or larger, copper or aluminum tubing is recommended. See accessory bulletin S-101 for fittings.

MAINTENANCE

Maintenance: No lubrication or periodic servicing is required. Keep case exterior and cover clean. Occasionally disconnect pressure lines to vent both sides of gage to atmosphere and re-zero. Optional vent valves, (bulletin S-101), should be used in permanent installations.

Calibration Check: Select a second gage or manometer of known accuracy and in an appropriate range. Using short lengths of rubber or vinyl tubing, connect the high pressure side of the Magnehelic gage and the test gage to two legs of a tee. Very slowly apply pressure through the third leg. Allow a few seconds for pressure to equalize, fluid to drain, etc., and compare readings. If accuracy unacceptable, gage may be returned to factory for recalibration. To calibrate in the field, use the following procedure.

Calibration:

1. With gage case, P/N 1, held firmly, loosen bezel, P/N 4 by turning counterclockwise. To avoid damage, a canvas strap wrench or similar tool should be used.
2. Lift out plastic cover and "O" ring.
3. Remove scale screws and scale assembly. Be careful not to damage pointer.
4. The calibration is changed by moving the clamp, P/N. 70-b. Loosen the clamp screw(s) and move slightly toward the helix if gage is reading high, and away if reading low. Tighten clamp screw and install scale assembly.
5. Place cover and 0-ring in position. Make sure the hex shaft on inside of cover is properly engaged in zero adjust screw, P/N 230-b.
6. Secure cover in place by screwing bezel down snug. Note that the area under the cover is pressurized in operation and therefore gage will leak if not properly tightened.
7. Zero gage and compare to test instrument. Make further adjustments as necessary.

Caution: If bezel binds n installing, lubricate threads sparingly with light oil or molybdenum sulphate compound.

Warning: Attempted field repair may void your warranty. Recalibration or repair by the user is not recommended. For best results, return gage to the factory.

Trouble Shooting Tips:

• *Gage won't indicate or is sluggish.*

1. Duplicate pressure port not plugged.
2. Diaphragm ruptured due to overpressure.
3. Fittings or sensing lines blocked, pinched, or leaking.
4. Cover loose or "O" ring damaged, missing.
5. Pressure sensors, (static tips, Pitot tube, etc.) improperly located.
6. Ambient temperature too low. For operation below 20°F, order gage with low temperature, (LT) option.

• *Pointer stuck-gage can't be zeroed.*

1. Scale touching pointer.
2. Spring/magnet assembly shifted and touching helix.
3. Metallic particles clinging to magnet and interfering with helix movement.
4. Cover zero adjust shaft broken or not properly engaged in P/N 230-b adjusting screw.

We generally recommend that gages needing repair be returned to the factory. Parts used in various sub-assemblies vary from one range of gage to another, and use of incorrect components may cause improper operation or failure. Gages repaired at the factory are carefully calibrated and tested to assure "like-new" operation. After receipt and inspection, we will be happy to quote repair costs before proceeding.

Consult factory for assistance on unusual applications or conditions.

Use with air or compatible gases only.

DWYER INSTRUMENTS, INC.
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DUALL CENTRIFUGAL EXHAUST FAN

INSTALLATION, OPERATION & MAINTENANCE INSTRUCTIONS

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SAFETY INSTRUCTIONS

Because they contain high-speed rotating parts, fans and their accessories can present certain dangers to installation and maintenance personnel. Carelessness can result in serious injury. The following precautions are most important:

1. In addition to the obvious hazards associated with the moving parts of rotating machinery, fans present additional potential hazards that are not so obvious and should be considered by the user for safe operation.

2. Fans operate by creating suction and air pressure which can be hazardous. Solid objects can be drawn into a fan's inlet and then become dangerous projectiles when they are exhausted through the fan's outlet. **SOLID OBJECTS CAN ALSO CAUSE FAN FAILURE OR IMPELLER FAILURE DUE TO IMBALANCE OR DAMAGE TO THE IMPELLER BLADES.** Personnel in close proximity to a fan inlet can be overcome by the suction, and drawn into the fan.

   Whenever there is a possibility that solid objects can be drawn into a remote intake, the intake should be guarded at all times. Before a guard is removed, the fan should be disconnected and the power supply locked out.

   Where fans are installed over an occupied area, safety guards should be provided to prevent dropped objects from entering this area during installation and maintenance.

3. Access doors to a fan or duct system should never be opened while the fan is operating or coasting to a stop. On the downstream (or pressure) side of the system, releasing the door with the system in operation may result in an explosive opening. On the upstream (or suction) side, the inflow may be sufficient to draw in tools, clothing, and other materials. The power supply should always be locked out prior to accessing a fan or ductwork. Fan design sometimes requires access doors to be supplied with internal components such as a plug to fill a hole in the fan casing. These doors can often be heavy and difficult to handle. Care should be exercised when opening, removing, and installing these components.

4. Even when the power supply is locked out, fans may cause injury or damage if the impeller is subject to "windmilling" which is the turning of the impeller and drive components due to a draft in the system. To guard against this hazard, the impeller should be secured to physically restrict rotational movement.

5. Many fans, fan motors, and fan components run at temperatures that could burn someone who comes in contact with the hot areas, including discharged or leaking gases. If this potential hazard is present, steps should be taken so that personnel working near the fan are aware of the danger and can exercise caution.

6. Some fans can generate sound that could be hazardous to exposed personnel. Sound pressure can be measured in the field, but obtaining accurate data is difficult. The environment in which the fan operates can impact the ability to obtain accurate fan sound readings. Consult the manufacturer for fan sound data. It is the responsibility of the user, and maintainer to comply with specific safety requirements mandated by federal, state, and local codes; and to follow industry safety standards and practices published by AMCA and by other recognized agencies and associations, regarding personnel safety from exposure to fan noise associated with use and exposure to the equipment.

7. Every fan should be installed with a suitable device allowing it to be completely disconnected or isolated from the power supply. Many fans are started by remote switches or push-buttons, by interlocks with other equipment, or by automatic controls. Before performing any maintenance, inspection, or other activity which will require removal of guards, ductwork, access doors, etc., or exposure of moving parts, the fan power supply should be locked out and the fan tagged out of service.

   In cases where the fan is power driven by a source other than an electric motor, appropriate provisions should be made for the isolation or disengagement of the power supply.

8. Make a periodic inspection of the fan wheel, bearings, and drive to be sure that corrosion and/or abrasion has not set in to weaken them. Corrosion and/or abrasion indicates danger of mechanical failure. Corroded or worn parts should be replaced.

HANDLING & STORAGE

When they are received, immediately unpack and inspect the fan and accessories. Any visible sign of damage should be noted on the delivery receipt. Rotate the fan wheel by hand to see that it turns freely and does not bind. Check to see that all other parts or accessories are in satisfactory condition. It is the customer's responsibility to note any damage in case of a claim. No material or equipment may be returned without our prior written consent which, if granted, will include shipping instructions that must be followed.

Fans should be lifted by their bases or by the lifting eyes or lugs provided for that purpose. Never lift the fan by the shaft or housing.

During shipping and storage, fans should be protected from the elements and from falling construction debris. Machined parts should be protected by coating with grease. Cover inlet and outlet openings to prevent the accumulation of dirt and moisture in the housing. If outdoor storage is necessary, enclose the fan within a reflective covering, which is positioned in such a manner that air is allowed to circulate around the equipment. This will help to prevent build-up of excessive heat and moisture.

Rotate the fan wheel at least every thirty days in order to coat the bearings with lubricant. This helps to retard oxidation and corrosion, and reduces the possibility of false brinelling. At the same time, purge the bearings with grease in order to remove condensed moisture. Rotate the wheel while greasing and do not use high-pressure greasers. In severe weather or where the temperature varies greatly, this procedure should be done more often.

INSTALLATION

1. Place the fan on a rigid foundation such as a concrete base or a steel platform. This is necessary for ensuring vibration-free equipment. The weight of the foundation should be two to three times the weight of the fan and motor. The foundation should extend beyond the outline of the fan by at least six inches.

   Platforms should be of welded construction in order to maintain permanent alignment of all members. They should have sufficient diagonal bracing for supporting the load and preventing side sway. An insufficient platform or foundation can produce a state of vibration that is not a result of fan imbalance. It is the responsibility of the owner to provide an appropriate platform or foundation.

2. Level the fan by shimming where necessary and then anchor the fan securely to the foundation. If the base is not properly shimmed, the fan housing can distort causing the wheel to rub the inlet cone.

   The separation distance between the inlet sleeve of the fan and the end of the inlet air duct should be ½"-1". This is the optimum distance to isolate the fan from the air duct system and provide adequate support for the flexible connection.

   If vibration isolators are to be used, they should be installed between the fan and the foundation. Make sure that the fan and its drive motor are not on independently isolated foundations or bases.

3. Connect the drain coupling on the housing to the waste drain. Provide a trap or submerge the end of the pipe to prevent loss of air. The depth of the trap or submergence must be greater than the fan static pressure rating.

4. Install all safety accessories - belt and shaft guards, inlet screens - before start-up.

5. For FW scrubbers, which include an integral fan, refer to **Packed Bed Scrubber O & M 221-18** for scrubber installation instructions.

START-UP CHECK LIST

6. 6.1 General

6.1.1 Before putting any fan into initial operation, the manufacturer's instructions should be followed. Transportation, handling, and installation can cause fasteners to loosen, and cause misalignment of fan components. Carefully follow this check list when commissioning equipment.

6.1.2 Lock out the primary and all secondary power sources.

6.1.3 A complete inspection should be made of all of the ductwork and the interior of the fan. Make certain there is no foreign material which can be drawn into or blown through the fan or ductwork. Appropriate protective measures and safety practices should be observed when entering or working within these areas. These measures might include the use of goggles, respirators, or other personal protective devices.

6.1.4 Make sure the foundation or mounting arrangement and the duct connections are adequately designed and installed per drawings and in accordance with recognized acceptable engineering practices and with the fan manufacturer's recommendations.

6.1.5 Check and tighten all bolts, fasteners, and set screws as necessary.

6.1.6 Check the fan assembly and bearings for proper grounding to prevent static electricity discharge.

6.1.7 Check bearings for recommended lubricant and lubrication amount.

6.1.8 Spin the rotating assembly by hand to determine whether it rotates freely, without hitting anything, and is not grossly out of balance.

6.1.9 Ensure power and drive components such as motor starter, variable frequency drive, or hydraulic power unit are properly sized, matched, and connected to the fan. Ensure use of correct voltage. Wire the motor in accordance with all applicable electrical codes. Check motor rotation to ensure proper operation by bump starting the motor.

6.1.10 Inspect impeller for proper rotation for the fan design.

6.1.11 Check alignment of drives and all other components.

6.1.12 Check the belt drive for proper sheave selection and installation and make sure the sheaves are not reversed. When the sheaves are reversed, it is possible to either run the fan at twice or half the design speed. If the fan runs at twice the design speed, catastrophic damage to the fan and serious injury to persons in the area could result.

6.1.13 Check belt tension often. Ideal tension is the tension at which the belt will not slip under peak load conditions. Over-tensioning shortens belt and bearing life. Keep belts free from foreign material which may cause slipping. The use of belt dressing is not recommended. See Appendix A for recommend tensioning.

6.1.14 Properly secure all safety guards and inlet screen.

6.1.15 Assure that all appropriate warnings have been put in place.

6.1.16 Secure all access doors to the fan and ductwork.

6.1.17 Momentarily energize the fan to check the direction of rotation. Listen as the fan coasts to a stop for any unusual noise, identify the source, and take corrective action as necessary. Any severe out of balance condition should be reported immediately. Do not run the fan in an out of balance condition. To avoid overloading the motor, block the inlet (i.e. induce static pressure loss) while performing this check.

6.1.18 Switch on the electrical supply and allow the fan to reach full speed. Check fan speed with a tachometer. Check carefully for:

(1) Excessive vibration
(2) Unusual noise
(3) Proper belt alignment
(4) Proper lubrication
(5) Proper amperage, voltage, or power values.
(6) If any problem is indicated, **SWITCH OFF IMMEDIATELY.**
(7) Lock out the power supply. Secure the fan impeller if there is a potential for windmilling. Check carefully for the cause of the trouble, correct as necessary, and repeat check list procedure.

6.2 Even if the fan appears to be operating satisfactorily, shut down after a brief period, lock out the power supply, and recheck items 6.1.5 through 6.1.17 as the initial start-up may have loosened the bolts, fasteners, and set screws.

6.3 Install inlet and outlet ducting as required. Ductwork should be self-supporting since its weight may distort the fan housing, causing contact between wheel and inlet cone.

6.4 The fan may now be put into operation, but during the first eight hours of running, it should be closely observed and checked for excessive vibration and noise. At this time checks should also be made of motor input current and motor and bearing temperatures to ensure that they do not exceed manufacturer's recommendations.

6.5 After eight hours of operation, the fan should be shut down and the power locked out. Check list items 6.1.5 through 6.1.17 should be inspected and adjusted, if necessary.

6.6 After twenty-four (24) hours of satisfactory operation, the fan should be shut down (locked out) and the drive belt tension should be readjusted to recommended tension. Tighten all bolts and set screws to manufacturer's specifications (consult maintenance section of these instructions).

6.7 After commissioning and start-up, the fan should be operated and maintained in accordance with the manufacturer's and component manufacturer's recommendations.

MAINTENANCE

Periodic inspection of all fan parts is essential to ensuring proper operating condition. The frequency of these inspections depends on the application and on the condition of the air being handled. We suggest, however, that the inspection interval not exceed one month.

CAUTION: Be sure that electrical supplies have been completely disconnected and locked out before attempting any fan maintenance. If a disconnect switch has not been provided, remove all fuses from the circuit and lock the fuse panel.

Fan Wheel

Inspect the fan wheel for any build-up of foreign material and for excessive wear. Make sure that the impeller coating is continuous and that no bubbles or pinholes are present. Any build-up of foreign material should be removed. Do not use sharp objects which might damage the coating or laminate surface, thereby reducing corrosion resistance.

If the fan wheel shows excessive wear or other condition causing severe unbalance, it should be replaced immediately. Follow instructions outlined below.

Belts and Drive

Replace sheaves that are corroded or that have worn grooves, burrs or rough spots. These conditions impair drive efficiency and shorten belt life.

Check V-belt drive for proper alignment and belt tension as stated in paragraphs 6.1.11 and 6.1.13. Belts must be perpendicular to fan and motor shafts. If belts show wear, they should be replaced. On multiple belt drives, be sure to replace all belts. Never replace only a single belt from a multiple belt set.

Dirt and grease reduce belt life. Clean belts with methyl chloroform, a suitable solvent, or with soap and water.

Check tightness of all set screws and bolts. Adjust per the following schedule:

Set screws		Hold-Down Bolts	
Size (in. -	Torque lb.)	Size (in. -	Torque lb.)
10-32	33	3/8-16	240
1/4-28	87	1/2-13	600
5/16-24	165	5/8-11	1200
3/8-24	290	3/4-10	2100
7/16-20	430	7/8- 9	2000

Bearings

Grease-lubricated bearings are standard on Duall fans. Bearings are completely filled with grease prior to shipment from the factory. They require periodic lubrication in order to ensure longer life and smooth operation. The frequency of lubrication depends on the conditions under which the bearing must operate. Use the guidelines concerning bearing maintenance which are outlined below.

Pedestal

Periodically inspect the fan pedestal for cracks or other signs of wear. Touch up the coating as necessary to prevent corrosion.

Shaft Seals

When provided, shaft seals should be inspected whenever the other parts are inspected. Replace them when they are worn. Reference Duall O & M manuals 221-23 or 221-29 as needed.

IMPELLER REMOVAL AND REPLACEMENT

To remove the wheel:

- Remove belt guard, shaft guard, belts, and sheaves.
- Remove rust and other material from the fan shaft with emery paper.
- Loosen set screws on the bearing's self-locking collar. Turn the collar in a direction opposite to that in which the impeller normally rotates in order to loosen. File smooth any burrs from the set screws in order to be able to remove the shaft, and to prevent damage to the bearing.
- Remove the inlet cone. To make re-installation easier, draw match marks on the cone and housing before proceeding. With a putty knife, remove PVC caps on bolts holding the collar of the fan inlet cone. Remove the bolts and slide the cone out of the housing.
- Slide the wheel and shaft assembly through the inlet opening in the fan housing.

To replace the wheel:

- Insert the shaft into the bearings but do not tighten bearing set screws.
- Replace the inlet cone and hand tighten in place.
- Pull wheel clear of inlet cone by sliding wheel/shaft assembly toward drive side.
- Measure back approximately 3/16 inches from the front edge of the wheel and place a mark on the inside surface. Use a wax pencil or other soft marker. Do not use a sharp instrument which may damage the surface.
- Move the wheel to align this mark with the edge of the inlet cone.
- Using finger tips, center the inlet cone in front shroud ring of the wheel. Tighten bolts holding the cone. Reglue PVC caps, using cleaner and PVC solvent glue.
- Tighten bearing locking collars and set screws in accordance with the manufacturer's recommendation. Collars lock when turned in the direction in which the shaft normally rotates. Tighten nuts and bolts on inlet side holding bearing.
- Check assembly for proper clearances while rotating wheel by hand.

- Re-tighten all bolts, locking collars, and set screws after 8 hours operation and again after 24 hours.

FAN DRIVE REMOVAL AND REPLACEMENT

Motors are provided with slide rail bases. They should be mounted as follows:

- Anchor the motor slide base to the foundation or bearing base.
- Coat studs on the slide base with grease to inhibit corrosion.
- Mount the motor on the slide base.

V-belt drives should be mounted as follows:

- Remove dirt and corrosion from fan and motor shafts.
- Coat bore of sheaves with grease or oil and mount sheaves on the shaft. Do not force the sheave onto the shaft by hammering as this can damage both shaft and bearings.
- Move the motor to the position closest to the fan shaft by adjusting the motor slide base.
- Install the belts by working them over the grooves of each sheave until they are in place. Never use a screwdriver or similar tool to install belts since this may break the cords in the belts.
- Using a straightedge, adjust the sheaves so that both shafts are at right angles to the belts. Tighten sheaves in place.
- Take up belt slack by adjusting the motor slide base. Use drive manufacturer's recommendations for correct belt tension. Proper tension is indicated by slight bowing on the slack side of the belt. If belts are too tight, excessive wear on fan and motor bearings will result. Insufficient tension shortens belt life and may cause vibration.
- Install belts and shaft guards before operating.
- Check belt tension and sheave alignment after several days of operation.

BEARING LUBRICATION AND REPLACEMENT

The bearings will discharge excess grease through the seals for a short period of time after start-up. Do not replace this initial discharge. Leakage will cease after the excess grease has been

purged from the bearings. The bearing will also tend to run hotter than usual during initial start-up.

Bearings require periodic lubrication in order to ensure longer life and smooth operation. The frequency of lubrication depends on the conditions under which the bearing must operate. In clean, dry environments having ambient temperatures of -30°F to 150°F we suggest the following schedule:

Suggested Lubrication Period in Weeks

Hours Run	Maximum Shaft Speed (rpm)							
Per Day	250	500	750	1000	1500	2000	2500	3000
8	36	36	34	31	29	28	27	26
16	36	31	29	28	28	26	24	24
24	34	29	27	26	24	24	24	24

In atmospheres containing dust, water, or corrosive vapors the frequency of lubrication should be increased. The bearings should be kept full. Slight leakage of grease from the seal will help to prevent entrance of foreign material.

When lubricating bearings make sure that the fan is operating or at least that the wheel is rotated. This will help to distribute the grease. Clean the grease fitting before you start in order to prevent contamination. Pump in only enough grease to force a slight film of grease under the seal all around the bearing. Observe the grease that is expelled. Black grease or foreign material in the grease indicate that the greasing frequency should be increased.

Do not over-lubricate. Too much grease causes overheating. If excess grease in the bearing causes overheating, remove the grease fitting to allow excess grease to escape.

Do not use two types of grease in the same bearing. Flush old grease from bearings before adding new grease of a different type. Care should be taken so that the seals are not blown out due to excess pressure.

Bearings are lubricated at the factory with a lithium base grease having No. 3 consistency. Relubrication with a similar grease that is suitable for ball bearing service is recommended. If you are not familiar with the application, consult a reputable grease manufacturer.

The following greases or their equivalent are recommended:

Shell	Alvania #3, Dolium #2, Darina #2
Chevron	SRI #2
Texaco	AFB #2, Multifac EP #2
Mobil	Mobilux #2
Gulf Oil	Gulf Crown #2
Imperial	Molub #2
Standard	Amolith #2

To mount new bearings:

- Inspect the shaft for wear at the bearing mounting positions. Shaft diameter should not be undersized more than commercial ground and polished tolerances.

- Place new bearings loosely on the shaft. Drop mounting bolts in place and make them snug. Adjust the position of the shaft with proper spacing at either end.

- Center both ends of the shaft in the bearing housing. Use the clearance in the mounting holes for horizontal adjustment, and shims for vertical adjustment.

- Tighten the bearings to the base plate and check the position of the shaft for proper alignment. The shaft should slide freely end to end.

- Refer to the section on wheel replacement for correct position of fan wheel in relation to the inlet cone.

- Tighten the locking collar and set screws of the bearing closest to the wheel in accordance with the manufacturer's recommendation. Collars lock when turned in the direction in which the shaft normally rotates. Dimple the shaft beneath the set screw to prevent slipping on vertically-mounted shafts.

- Grasp the sheave end of the shaft and pull away from the wheel while tapping the locking collar of the bearing closest to the sheave with a soft mallet in the opposite direction, i.e. toward the wheel.

- Tighten the locking collar and set screws of the sheave-end bearing in accordance with the manufacturer's recommendation. Collars lock when turned in the direction in which the shaft normally rotates. Dimple the shaft beneath the set screw to prevent slipping on vertically-mounted shafts.

- Re-tighten all bolts, locking collars, and set screws after 8 hours operation and again after 24 hours.

TROUBLESHOOTING

Excessive Vibration/Noise

1. Loose mounting bolts, set screws, bearings, or couplings.
2. Misalignment or excessive wear of couplings or bearings.
3. Misaligned or unbalanced motor.
4. Bent shaft due to mishandling or impact.
5. Accumulation of foreign material on wheel.
6. Excessive erosion (wear) of the wheel.
7. Excessive system pressure or airflow restriction due to closed damper or small duct.
8. Inadequate structural support, mounting procedures, or materials.
9. Externally transmitted vibrations; resonance or pulsation.
10. Fan operating near stall point due to incorrect system design or installation.
11. Improper location/orientation of fan intake and discharge.
12. Nearby sound reflecting surfaces.

Inadequate Performance

1. Incorrect testing procedure or calculations.
2. Fan running too slowly. Check shaft speed with tachometer.
3. Wheel rotating in wrong direction or installed backwards.
4. Wheel not properly centered on inlet.
5. Damaged or improperly installed cutoff.
6. Poor system design, closed dampers, air leaks, or clogged filters.

7. System effects due to sharp elbows near inlet or sharp deflection near outlet.

Premature Failure

1. Prolonged or major vibration.
2. Inadequate or improper maintenance.
3. Abrasive or corrosive elements in the airstream or surrounding atmosphere.
4. Misalignment or damage to rotating components.
5. Bearing failure.
6. Excessive fan speed.
7. Extreme temperatures.

#########

APPENDIX A

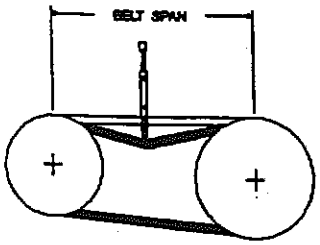
Browning BELT TENSION CHECKER

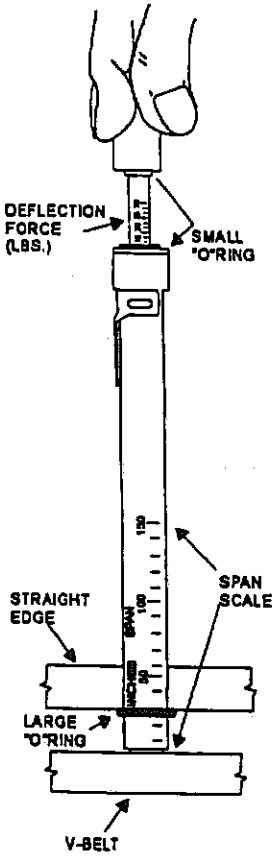
TENSIONING V-BELT DRIVES WITH A BROWNING TENSION CHECKER

⚠WARNING
Failure to observe safety precautions could cause personal injury or equipment damage.

General rules of tensioning.

1. Ideal tension is the lowest tension at which the belt will not slip under peak load conditions.
2. Check tension frequently during the first 24-48 hours of operation.
3. Over tensioning shortens belt and bearing life.
4. Keep belts free from foreign material which may cause slip.
5. Make V-drive inspection on a periodic basis. Tension when slipping. Never apply belt dressing as this will damage the belt and cause early failure.





TENSION MEASUREMENT PROCEDURE

1. Measure the belt span (see sketch).
2. Position bottom of the large "O" ring on the span scale at the measured belt span.
3. Set the small "O" ring on the deflection force scale to zero.
4. Place the tension checker squarely on one belt at the center of the belt span. Apply a force on the plunger and perpendicular to the belt span until the bottom of the large "O" ring is even with the top of the next belt or with the bottom of a straight edge laid across the sheaves.
5. Remove the tension checker and read the force applied from the bottom of the small "O" ring on the deflection force scale.
6. Compare the force you have applied with the values given in the tables on this card. The force should be between the minimum and maximum shown. The maximum value is shown for "New Belt" and new belts should be tensioned at this value to allow for expected tension loss. Used belts should be maintained at the minimum value as indicated in the chart. IF THE BELT SPAN WAS MEASURED IN INCHES, THEN USE THE POUNDS OF FORCE VALUES FOR COMPARISON. IF THE BELT SPAN WAS MEASURED IN CENTIMETERS, THEN USE THE KILOGRAMS OF FORCE VALUES FOR COMPARISON.

NOTE: The ratio of deflection to belt span is 1:64 in either units of measurements.

⚠WARNING Disconnect all power while adjusting units

SHEAVE DIAM - INCHES
DEFLECTION FORCE - LBS.

Belt Cross Section	Smallest Sheave Diameter Range	RPM Range	Belt Deflection Force			
			Super Gripbelts and Unnotched Gripbands		Gripnotch Belts and Notched Gripbands	
			Used Belt	New Belt	Used Belt	New Belt
A,AX	3.0 - 3.6	1000-2500	3.7	5.5	4.1	6.1
		2501-4000	2.8	4.2	3.4	5.0
	3.8 - 4.8	1000-2500	4.5	6.8	5.0	7.4
		2501-4000	3.8	5.7	4.3	6.4
	5.0 - 7.0	1000-2500	5.4	8.0	5.7	9.4
		2501-4000	4.7	7.0	5.1	7.6
B,BX	3.4 - 4.2	860-2500	-	-	4.9	7.2
		2501-4000	-	-	4.2	6.2
	4.4 - 5.6	860-2500	5.3	7.9	7.1	10.5
		2501-4000	4.5	6.7	7.1	9.1
	5.8 - 8.6	860-2500	6.3	9.4	8.5	12.6
		2501-4000	6.0	8.9	7.3	10.9
C,CX	7.0 - 9.0	500-1740	11.5	17.0	14.7	21.8
		1741-3000	9.4	13.8	11.9	17.5
	9.5 - 16.0	500-1740	14.1	21.0	15.9	23.5
		1741-3000	12.5	18.5	14.6	21.6
D	12.0 - 16.0	200-850	24.9	37.0	-	-
		851-1500	21.2	31.3	-	-
	18.0 - 20.0	200-850	30.4	45.2	-	-
		851-1500	25.8	38.0	-	-
3V,3VX	2.2 - 2.4	1000-2500	-	-	3.3	4.9
		2501-4000	-	-	2.9	4.3
	2.65 - 3.65	1000-2500	3.6	5.1	4.2	6.2
		2501-4000	3.0	4.4	3.8	5.6
	4.12 - 6.90	1000-2500	4.9	7.3	5.3	7.9
		2501-4000	4.4	6.6	4.9	7.3
5V,5VX	4.4 - 6.7	500-1749	-	-	10.2	15.2
		1750-3000	-	-	8.8	13.2
		3001-4000	-	-	5.6	8.5
	7.1 - 10.9	500-1740	12.7	18.9	14.8	22.1
		1741-3000	11.2	16.7	13.7	20.1
	11.8 - 16.0	500-1740	15.5	23.4	17.1	25.5
		1741-3000	14.6	21.8	16.8	25.0
8V	12.5 - 17.0	200-850	33.0	49.3	-	-
		851-1500	26.8	39.9	-	-
	18.0 - 22.4	200-850	39.6	59.2	-	-
		851-1500	35.3	52.7	-	-

SHEAVE DIAM - MILLIMETERS
DEFLECTION FORCE - KG.

Belt Cross Section	Smallest Sheave Diameter Range	RPM Range	Belt Deflection Force			
			Super Gripbelts and Unnotched Gripbands		Gripnotch Belts and Notched Gripbands	
			Used Belt	New Belt	Used Belt	New Belt
A,AX	75 - 90	1000-2500	1.7	2.5	1.9	2.8
		2501-4000	1.3	1.9	1.5	2.3
	91 - 120	1000-2500	2.0	3.1	2.3	3.4
		2501-4000	1.7	2.6	2.0	2.9
	121 - 175	1000-2500	2.4	3.6	2.6	4.3
		2501-4000	2.1	3.2	2.3	3.4
B,BX	85 - 105	860-2500	-	-	2.2	3.3
		2501-4000	-	-	1.9	2.8
	106 - 140	860-2500	2.4	3.6	3.2	4.8
		2501-4000	2.0	3.0	3.2	4.1
	141 - 220	860-2500	2.9	4.3	3.9	5.7
		2501-4000	2.7	4.0	3.3	4.9
C,CX	175 - 230	500-1740	5.2	7.7	6.7	9.9
		1741-3000	4.3	6.3	5.4	7.9
	231 - 400	500-1740	6.4	9.5	7.2	10.7
		1741-3000	5.7	8.4	6.6	9.6
D	305 - 400	200-850	11.3	16.8	-	-
		851-1500	9.6	14.2	-	-
	401 - 510	200-850	13.8	20.5	-	-
		851-1500	11.8	17.2	-	-
3V,3VX	55 - 60	1000-2500	-	-	1.5	2.2
		2501-4000	-	-	1.3	2.0
	61 - 90	1000-2500	1.6	2.3	1.9	2.8
		2501-4000	1.4	2.0	1.7	2.5
	91 - 175	1000-2500	2.2	3.3	2.4	3.6
		2501-4000	2.0	3.0	2.2	3.3
5V,5VX	110 - 170	500-1749	-	-	4.6	6.9
		1750-3000	-	-	4.0	6.0
		3001-4000	-	-	2.5	3.9
	171 - 275	500-1740	5.6	8.6	6.7	10.0
		1741-3000	5.1	7.6	6.2	9.1
	276 - 400	500-1740	7.0	10.6	7.8	11.8
		1741-3000	6.6	9.9	7.6	11.3
8V	315 - 430	200-850	15.0	22.4	-	-
		851-1500	12.2	18.1	-	-
	431 - 570	200-850	18.0	26.8	-	-
		851-1500	16.0	23.9	-	-

The above method of tensioning belt drives is to be used when a drive has been selected in accordance with the suggestions listed in the drive selection tables of the Browning catalog. **For drives with service factor greater than 1.5, consult Browning.** For exact tension calculations, use the Browning EDGE® Selection Program.

Form #5453-H 5/22/96
Printed in U.S.A.

BROWNING
Emerson Power Transmission Corp.
MAYSVILLE, KENTUCKY 41056

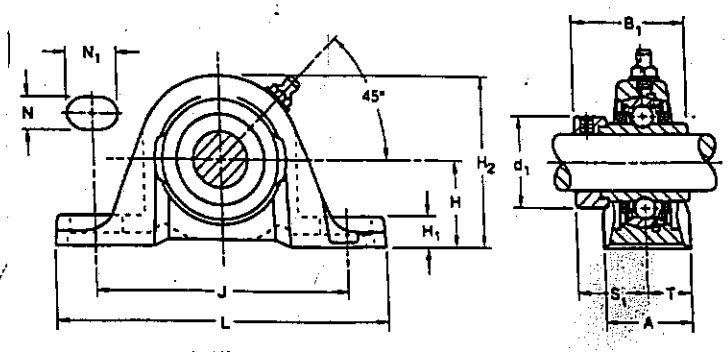
RAS, [illegible], Standard Series

Fafnir RAS and TAS type pillow blocks are similar in design and equal in load carrying capacity to the RAK and TAK types, but have slightly different base to center height dimension to make them interchangeable with certain other competitive designs.

The RAS pillow block is equipped with G-KRRB (R-Seal) wide inner ring bearings, TAS with G-KPPB (Tri-Ply Seal), and LAS with G-KLLB (Standard) wide inner ring bearings. Self-locking collars are supplied with all units.

Contact The Torrington Company to discuss highly corrosive applications (i.e. food processing, chemical exposure) where Fafnir TDC™ bearings can be utilized.

Recommended shaft tolerances: 1/2"-1 15/16", nominal to -.0005", -.013 mm; 2"-2 15/16", nominal to -.0010", -.025 mm.



Bearing Data

Unit	Bearing Number	Dimensions and Load Ratings
RAS	G...KRRB	Pages 143
TAS	G...KPPB	Pages 154
LAS	G...KLLB	Pages 151

TO ORDER, SPECIFY UNIT AND SHAFT DIAMETER. Example: RAS 1 3/16".

Unit	Shaft Diam.	H	H_2	B_1	J	L	A	H_1	N	N_1	d_1	S_1	T	Bolt Size	Bearing Number[1]		Collar Number	Housing Number	Unit Wt.
	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	RAS	(TAS)		New (Old)	lbs. kg
RAS	1/2														G1008KRRB		S1008K		
RAS	9/16														G1009KRRB		S1009K		
RAS	5/8	1 3/16	2 7/32	1 15/32	3 5/8	4 7/8	1 3/16	15/32	7/16	7/8	1 1/8	59/64	19/32	3/8	G1010KRRB		S1010K	T-40238	1.00
RAS	11/16	30.16	56.4	37.3	92.1	123.8	30.2	11.9	11.1	22.2	28.6	23.4	15.1	10	G1011KRRB		S1011K	(T-30595)	.454
RAS	17														GE17KRRB		SE17K		
RAS	3/4	1 5/16	2 17/32	1 23/32	3 25/32	5	1 1/4	17/32	7/16	25/32	1 5/16	1 3/64	5/8	3/8	G1012KRRB		S1012K	T-40239	1.40
	20	33.34	64.3	43.7	96.0	127.0	31.8	13.5	11.1	19.8	33.3	26.6	15.9	10	GE20KRRB		SE20K	(T-30555)	.635
RAS, TAS	13/16														G1013KRRB	(KPPB)	S1013K		
RAS, TAS	7/8														G1014KRRB	(KPPB)	S1014K		
RAS, TAS	15/16	1 7/16	2 13/16	1 3/4	4 1/8	5 1/2	1 13/32	19/32	7/16	13/16	1 1/2	1 1/16	45/64	3/8	G1015KRRB	(KPPB)	S1015K	T-30355	1.77
RAS, TAS, LAS	1	36.51	71.4	44.4	104.8	139.7	35.7	15.1	11.1	20.6	38.1	27.0	17.9	10	G1100KRRB	(KPPB)	S1100K		.803
RAS, TAS	25														GE25KRRB	(KPPB)	SE25K		
RAS, TAS	1 1/16														G1101KRRB	(KPPB)	S1101K		
RAS, TAS	1 1/8	1 11/16	3 9/32	1 29/32	4 5/8	6 3/16	1 9/16	21/32	9/16	15/16	1 47/64	1 3/16	25/32	1/2	G1102KRRB	(KPPB)	S1102K	T-40241	2.86
RAS, TAS, LAS	1 3/16	42.86	83.3	48.4	117.5	157.2	39.7	16.7	14.3	23.8	44.1	30.2	19.9	12	G1103KRRB	(KPPB)	S1103K	(T-30300)	1.297
RAS, TAS	30														GE30KRRB	(KPPB)	SE30K		
RAS, TAS	1 1/4														G1104KRRB	(KPPB)	S1104K		
RAS, TAS	1 5/16														G1105KRRB	(KPPB)	S1105K		
RAS, TAS	1 3/8	1 7/8	3 11/16	2 1/64	5 1/8	6 9/16	1 25/32	23/32	9/16	31/32	2 1/8	1 9/32	57/64	1/2	G1106KRRB	(KPPB)	S1106K	T-40242	3.69
RAS, TAS, LAS	1 7/16	47.62	93.7	51.2	130.2	166.7	45.2	18.3	14.3	24.6	54.0	32.5	22.7	12	G1107KRRB	(KPPB)	S1107K	(T-30410)	1.674
RAS, TAS	35														GE35KRRB	(KPPB)	SE35K		
RAS, TAS	1 1/2														G1108KRRB	(KPPB)	S1108KT		
RAS, TAS	1 9/16	1 15/16	3 15/16	2 7/32	5 3/8	7 1/16	1 7/8	3/4	9/16	1 1/32	2 3/8	1 3/8	15/16	1/2	G1109KRRB	(KPPB)	S1109KT	T-40243	4.74
RAS, TAS	40	49.21	100.0	56.4	136.5	179.4	47.6	19.0	14.3	25.2	60.3	34.9	23.8	12	GE40KRRB	(KPPB)	SE40K	(T-30484)	2.150
RAS, TAS	1 5/8														G1110KRRB	(KPPB)	S1110K		
RAS, TAS	1 11/16	2 1/8	4 3/16	2 7/32	5 7/8	7 17/32	2	3/4	9/16	1 1/8	2 1/2	1 3/8	1	1/2	G1111KRRB	(KPPB)	S1111K	T-40244	5.31
RAS, TAS	1 3/4	53.98	106.4	56.4	149.2	191.3	50.8	19.0	14.3	28.6	63.5	34.9	25.4	12	G1112KRRB	(KPPB)	S1112K	(T-30682)	2.409
RAS, TAS	45														GE45KRRB	(KPPB)	SE45K		
RAS, TAS	1 13/16														G1113KRRB	(KPPB)	S1113K		
RAS, TAS	1 7/8	2 1/4	4 1/2	2 15/16	6 7/32	7 1/8	2 3/16	3/4	23/32	1 5/32	2 3/4	1 1/2	1 3/32	5/8	G1114KRRB	(KPPB)	S1114K	T-40245	6.62
RAS, TAS, LAS	1 15/16	57.15	114.3	62.7	158.0	200.0	55.6	19.0	18.3	29.4	69.8	38.1	27.8	16	G1115KRRB	(KPPB)	S1115K	(T-30706)	3.003
RAS, TAS	50														GE50KRRB	(KPPB)	SE50K		
RAS, TAS	2														G1200KRRB	(KPPB)	S1200K		
RAS, TAS	2 1/16														G1201KRRB	(KPPB)	S1201K		
RAS, TAS	2 1/8	2 1/2	4 31/32	2 13/16	6 15/16	8 3/4	2 5/16	13/16	23/32	1 5/32	3	1 23/32	1 5/32	5/8	G1202KRRB	(KPPB)	S1202K	T-40246	8.60
RAS, TAS	2 3/16	63.50	126.2	71.4	176.2	222.3	58.7	20.6	18.3	29.4	76.2	43.7	29.4	16	G1203KRRB	(KPPB)	S1203K	(T-30738)	3.901
RAS, TAS	55														GE55KRRB	(KPPB)	SE55K		
RAS	2 1/4														G1204KRRB		S1204K		
RAS	2 5/16														G1205KRRB		S1205K		
RAS	2 3/8	2 3/4	5 15/32	3 1/16	7 13/32	9 7/16	2 3/8	15/16	23/32	1 5/32	3 5/16	1 27/32	1 3/16	5/8	G1206KRRB		S1206K	T-40247	12.15
RAS, LAS	2 7/16	69.85	138.9	77.8	188.1	239.7	60.3	23.8	18.3	29.4	84.1	46.8	30.2	16	G1207KRRB		S1207K	(T-31244)	5.511
RAS	60														GE60KRRB		SE60K		
RAS	2 15/16	3 1/4	6 15/32	3 5/8	8 1/2	10 5/8	2 3/4	1	7/8	1 1/4	4	2 9/32	1 3/8	3/4	G1215KRRB		S1215K	T-23423	19.90
RAS	75	82.55	164.3	92.1	212.2	269.9	69.9	25.4	22.2	31.8	101.6	54.8	34.9	20	GE75KRRB		SE75K		9.026

[1] Bearing number for RAS is G-KRRB. TAS unit uses G-KPPB type.

Note: All units have 1/8 pipe thread grease fitting except 1/2 - 1 1/16 and 3/4 units which have 1/4 - 28 fitting.

FAFNIR
BALL BEARING
TRANSMISSION UNITS

Pillow Blocks
Flange Units
Cartridge Units
Take Ups
Hanger Units
Special Units

WARRANTY

The Torrington Company will replace, free of charge, within ninety days from date of sale, any bearing which in its judgement has failed because of defective material or workmanship, provided it has been shown to have been properly mounted, adquately lubricated, and not subjected to abuse in operation or assembling. Such bearings must be returned to the factory, charges prepaid, and with complete information as to service. The Torrington Company assumes no responsibility for contingent or consequential damage in any event. This guarantee is in lieu of all warranties either expressed or implied.

IMPORTANT!

Directions for Mounting

and Lubrication

FAFNIR
INDUSTRIAL UNITS

Equipped with

Relubricatable Ball Bearings

TORRINGTON

Part of worldwide Ingersoll-Rand

FAFNIR PRELUBRICATED TRANSMISSION UNITS

INSTALLATION

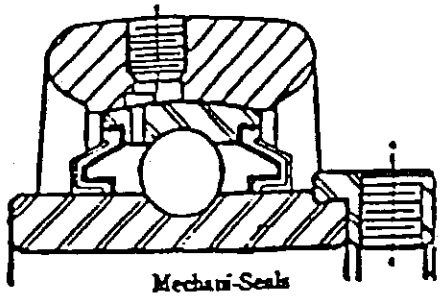
IMPORTANT:

Shaft must be up to size and straight and should be free from burrs. If old shaft is used, be sure ball bearing is not seated on worn section.

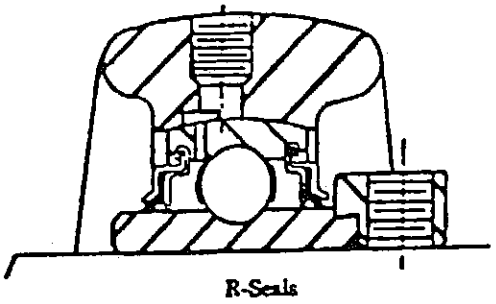
The proper mounting procedure is to:

1. Align the bearing in its housing and slide unit into position on the shaft.

2. Bolt the housing tightly to its mounting support.



Mechani-Seals



R-Seals

3. Slide collar against cam end of inner ring. Engage cams by rotating collar until it slides over cammed end of inner ring. Lock collar by tapping lightly in direction of shaft rotation. Tighten set screw.

NOTE: After installation of this unit and determination of correct rotation, check for proper engagement of collar and tightness of set screw.

To disassemble, loosen set screw and tap collar in direction opposite shaft rotation.

LUBRICATION

Bearings have been factory prelubricated with high quality grease and for normal conditions of service require no further lubrication.
Normal service is considered as operation in a clean, dry, atmosphere at temperatures between -30 degrees fahrenheit and 180 degrees fahrenheit and at shaft surface speeds up to 2100 ft. per minute. This corresponds to a 1" shaft at 8000 RPM, a 2" shaft at 4000 RPM or a 3" shaft at 2700 RPM.

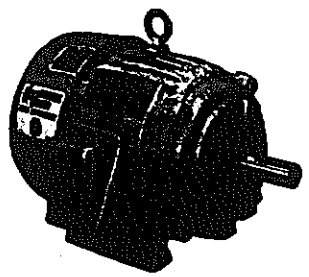
Where service is abnormal with respect to speed, temperature, exposure to moisture, dirt or corrosive chemicals, or where extremely long life is required, periodic relubrication may be advisable. The Torrington Company will advise of suitable greases for abnormal service on request.

SAFETY INSTRUCTIONS

1. This product must be properly installed and maintained to perform as intended by the manufacturer.
2. Before installation, consult manufacturer's recommendations.
3. Failure to adhere to manufacturer's recommendations may result premature product failure and/or personal injury.
4. Store product in a dry and clean area.
5. Do not open until ready to use.

TEFC HOSTILE DUTY
THREE PHASE
TYPES CT, J
1 - 200 HP

143T thru 449T Frame



For mill and chemical plants and other hostile environments.

HP	RPM	FRAME	MODEL NO.	LIST PRICE	DISC. SCHED.	TYPE	SERVICE FACTOR	NEMA NOM. EFF.	VOLTS (60 HZ)	APPROX. SHPG WT. (LB)
25	3600	284TS	E410	$1325	3X	CT	1.15	88.5	208-230/460	340
	3600	284TS	H264 ★	$1325	3X	CT	1.15	88.5	575	340
	1800	284T	E411	$1230	3X	CT	1.15	91.0	208-230/460	340
	1800	284T	H266	$1230	3X	CT	1.15	91.0	575	340
	1800	284TS	C509	$1230	3X	CT	1.15	91.0	208-230/460	340
	1200	324T	F204	$2094	3TE	CT	1.15	90.2	230/460	530
	1200	324T	H274 ★	$2094	3TE	CT	1.15	90.2	575	530
	900	326T	★	$3496	3M	CT	1.15	NA	230/460	590
	900	326T	★	$3496	3M	CT	1.15	NA	575	590
	720	365T	★	$5592	3M	CT	1.15	NA	230/460	800
	720	365T	★	$5592	3M	CT	1.15	NA	575	800
30	3600	286TS	E412	$1461	3X	CT	1.15	89.5	230/460	390
	3600	286TS	H265 ★	$1461	3X	CT	1.15	89.5	575	390
	1800	286T	E413	$1494	3X	CT	1.15	91.1	230/460	390
	1800	286T	H267	$1494	3X	CT	1.15	91.1	575	390
	1800	286TS	E414	$1494	3X	CT	1.15	91.1	230/460	390
	1200	326T	F205	$2556	3TE	CT	1.15	90.2	230/460	590
	1200	326T	H275 ★	$2556	3TE	CT	1.15	90.2	575	590
	900	364T	★	$4119	3M	CT	1.15	NA	230/460	750
	900	364T	★	$4119	3M	CT	1.15	NA	575	750
	720	405T	★	$6340	3M	CT	1.15	NA	230/460	1200
	720	405T	★	$6340	3M	CT	1.15	NA	575	1200
40	3600	324TS	F206	$1917	3TE	CT	1.15	90.2	230/460	530
	3600	324TS	H270 ★	$1917	3TE	CT	1.15	90.2	575	530
	1800	324T	F208	$1932	3TE	CT	1.15	91.7	230/460	530
	1800	324T	H272	$1932	3TE	CT	1.15	91.7	575	530
	1800	324TS	F207	$1932	3TE	CT	1.15	91.7	230/460	530
	1200	364T	F209	$3344	3TE	CT	1.15	91.0	230/460	750
	1200	364T	H280 ★	$3344	3TE	CT	1.15	91.0	575	750
	900	365T	★	$5102	3M	CT	1.15	NA	230/460	800
	900	365T	★	$5102	3M	CT	1.15	NA	575	800
	720	405T	★	$7769	3M	CT	1.15	NA	230/460	1200
	720	405T	★	$7769	3M	CT	1.15	NA	575	1200
50	3600	326TS	F210	$2658	3TE	CT	1.15	91.0	230/460	590
	3600	326TS	H271	$2658	3TE	CT	1.15	91.0	575	590
	1800	326T	F212	$2487	3TE	CT	1.15	92.4	230/460	590
	1800	326T	H273	$2487	3TE	CT	1.15	92.4	575	590
	1800	326TS	F211	$2487	3TE	CT	1.15	92.4	230/460	590
	1200	365T	F213	$3904	3TE	CT	1.15	91.0	230/460	800
	1200	365T	H281 ★	$3904	3TE	CT	1.15	91.0	575	800
	900	404T	★	$6078	3M	CT	1.15	NA	230/460	1000
	900	404T	★	$6078	3M	CT	1.15	NA	575	1000

Motors marked 208-230/460 volts may not meet all NEMA (MG-1) performance standards when operated at 208 volts.

★Product listed may not be available from stock

See Operating Characteristics, page 182
See Dimension Print, page 208

OPERATING CHARACTERISTICS
THREE PHASE
TOTALLY ENCLOSED FAN COOLED
T[illegible] E CT

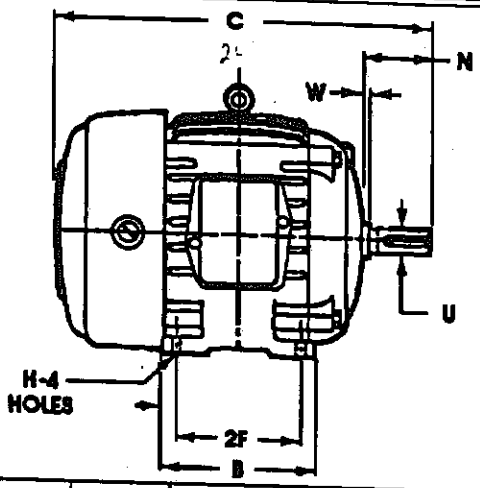
H.P.	SPEED R.P.M. SYN.	SPEED R.P.M. FULL LOAD	% EFFICIENCY † FULL LOAD	% EFFICIENCY † 3/4 LOAD	% EFFICIENCY † 1/2 LOAD	% POWER FACTOR † FULL LOAD	% POWER FACTOR † 3/4 LOAD	% POWER FACTOR † 1/2 LOAD	CURRENT IN AMPERES 230 VOLTS FULL LOAD	CURRENT IN AMPERES 230 VOLTS LOCKED STARTING	TORQUE AT FULL VOLTAGE◆ FULL LOAD TORQUE AT FULL LOAD SPEED	TORQUE AT FULL VOLTAGE◆ LOCKED (STARTING) PERCENT OF FULL LOAD	TORQUE AT FULL VOLTAGE◆ PULL OUT BREAK-DOWN PERCENT OF FULL LOAD	CODE
1	1800	1740	80.0	78.5	74.0	73.0	63.5	50.5	1.6	12.0	3.0	275	300	L
	1200	1145	76.0	75.0	70.5	64.5	54.5	42.0	2.2	10.0	4.3	170	250	L
1-1/2	3600	3485	77.5	77.0	72.5	86.0	80.0	68.5	2.1	16.5	2.3	175	250	K
	1800	1720	80.0	80.0	77.5	78.5	70.0	56.5	2.2	15.5	4.6	250	280	K
	1200	1145	75.0	74.5	70.0	66.5	57.0	44.0	2.8	15.5	6.9	165	250	K
2	3600	3475	79.5	79.5	76.5	87.0	81.5	71.0	2.7	21.5	3.0	170	240	L
	1800	1725	83.0	83.0	80.5	78.5	70.0	56.5	2.9	23.0	6.1	235	270	L
	1200	1150	76.5	75.5	70.5	62.0	52.5	40.0	4.0	24.5	9.1	160	240	L
3	3600	3465	79.5	80.0	77.5	84.5	78.5	67.5	4.2	24.5	4.6	160	230	K
	1800	1725	78.5	79.0	76.0	80.0	72.0	58.5	4.5	31.5	9.1	215	250	K
	1200	1150	79.5	80.5	78.0	71.5	63.5	51.0	4.9	22.0	13.7	155	230	K
5	3600	3470	82.5	83.0	81.0	86.5	82.0	73.0	6.8	44.5	7.6	150	215	J
	1800	1710	83.0	84.5	83.0	85.0	79.0	68.0	6.6	52.5	15.4	185	225	J
	1200	1150	83.0	83.0	80.0	65.0	56.5	43.5	8.7	44.0	22.8	150	215	J
7-1/2	3600	3475	84.5	85.5	84.0	87.0	84.0	77.0	9.6	54.5	11.3	140	200	H
	1800	1725	86.0	87.5	86.5	85.0	82.0	74.5	9.6	59.0	22.8	175	215	H
	1200	1160	85.0	85.5	84.0	81.5	75.0	63.5	10.1	63.0	34.0	150	205	H
10	3600	3480	86.0	87.0	86.0	87.5	84.5	77.5	12.4	76.0	15.1	135	200	H
	1800	1735	85.5	86.0	85.5	85.0	82.5	75.0	12.9	85.0	30.3	165	200	H
	1200	1155	86.0	87.5	86.5	83.5	78.5	68.5	13.0	80.5	45.5	150	200	H
15	3600	3520	85.0	85.55	83.0	89.5	88.5	84.0	18.5	111.0	22.5	130	200	G
	1800	1755	87.5	88.5	87.5	84.0	80.0	70.0	19.0	110.0	45.0	160	200	G
	1200	1160	86.5	88.0	87.5	81.0	77.0	67.0	20.0	106.0	68.0	140	200	G
20	3600	3505	86.0	87.0	85.5	89.0	88.5	85.5	24.5	137.0	30.0	130	200	G
	1800	1750	88.5	90.0	89.5	85.5	83.0	76.0	24.5	135.0	60.0	150	200	G
	1200	1160	86.5	88.5	88.0	83.0	79.0	70.5	23.0	143.0	91.0	135	200	G
25	3600	3510	84.5	85.0	82.5	87.5	86.5	81.5	32.0	179.0	37.5	130	200	G
	1800	1755	89.0	90.0	90.0	88.0	86.0	80.0	30.0	182.0	75.0	150	200	G
	1200	1135	88.5	90.0	89.2	82.0	83.0	76.5	31.0	174.5	113.0	135	200	G
30	3600	3510	87.5	88.5	87.5	89.5	89.5	86.5	36.0	212.5	45.0	130	200	G
	1800	1750	90.5	91.5	91.0	90.0	89.0	85.0	34.5	208.0	90.0	150	200	G
	1200	1135	88.0	90.0	90.0	86.0	84.5	79.5	37.0	225.0	136.0	135	200	G
40	3600	3525	88.5	89.5	88.5	88.0	88.0	85.0	45.0	261.0	60.0	125	200	G
	1800	1760	90.0	91.0	90.5	89.0	88.0	84.0	47.0	273.0	119.5	140	200	G
	1200	1170	89.5	90.5	90.0	87.0	84.5	78.0	48.0	289.0	180.0	135	200	G
50	3600	3530	90.0	91.0	90.0	89.0	89.5	87.0	58.5	355.0	75.0	120	200	G
	1800	1760	91.0	92.0	91.0	89.5	88.5	84.5	57.5	375.0	150.0	140	200	G
	1200	1165	90.0	91.0	91.0	88.0	87.0	82.5	59.0	341.0	225.0	135	200	G
60	3600	3520	91.0	91.5	90.5	88.5	87.5	83.0	70.0	438.0	90.0	120	200	G
	1800	1770	91.0	91.5	91.0	87.0	86.5	82.0	71.0	399.0	178.0	140	200	G
	1200	1170	91.5	91.5	90.5	85.0	82.0	75.0	73.0	434.0	270.0	135	200	G
75	3600	3550	91.5	91.5	90.5	89.0	88.0	83.5	86.0	537.0	112.0	105	200	G
	1800	1770	92.0	92.0	91.5	86.5	85.5	80.0	88.0	545.0	222.5	140	200	G
	1200	1170	92.5	93.5	93.0	85.5	84.5	80.5	89.0	547.0	337.0	135	200	G
100	3600	3520	92.0	92.0	90.5	90.0	89.0	85.0	113.0	740.0	150.0	105	200	G
	1800	1765	92.5	92.5	91.0	86.0	83.0	76.0	118.0	717.0	297.0	125	200	G
	1200	1185	92.3	92.3	91.8	85.3	82.4	75.0	119.0	656.0	443.0	125	200	G
125	3600	3555	92.1	92.0	90.7	90.2	89.5	86.2	141.0	898.0	184.0	100	200	G
	1800	1775	91.3	91.2	89.6	88.4	86.5	81.3	146.0	825.0	369.0	110	200	F
	1200	1185	93.6	94.4	94.1	85.7	83.3	76.5	174.0	891.0	664.0	125	200	G
150	3600	3560	92.8	92.8	91.5	89.9	89.2	85.8	168.0	1012.0	221.0	100	200	G
	1800	1780	92.3	92.3	91.1	88.6	86.7	81.6	172.0	1060.0	442.0	110	200	G
200	3600	3560	94.0	94.3	93.6	89.9	89.4	86.4	221.0	1588.0	295.0	100	200	G
	1800	1780	93.6	93.9	93.2	89.4	88.5	84.5	223.0	1417.0	590.0	100	200	G

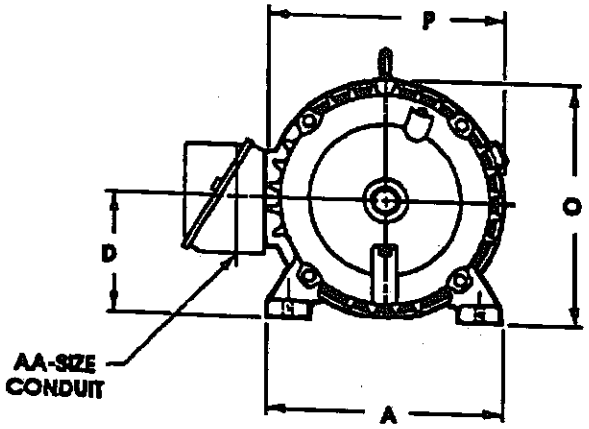
† Values shown are representative, not guaranteed.

▲ Full load efficiency is U.S.E.M.'s average calculated value based upon previous tests. This value will usually vary from the NEMA [illegible]minal nameplated value, which has to be selected from the NEMA table per MG1-12.58, in order to comply with NEMA standards [illegible] 1 through 200 HP, 3 phase.

◆ NEMA values.

HORIZONTAL MOTOR DIMENSIONS
THREE PHASE - CAST IRON TEFC
& EXPLOSIONPROOF
TYPES CT, CTE, TCE, CE, LE, L, NC, LC





FRAME	A	B	C	D	2F	H	MAX. N	MAX. O	MAX. P	U	MAX. AA	SQ KEY
56	6-1/2	4	12-1/2	3-1/2	3	11/32	2-11/64	7-1/2	7-3/4	5/8	3/4	3/16
143T	6-1/2	6	12-11/16	3-1/2	4	11/32	2-3/8	7-1/2	8	7/8	3/4	3/16
145T	6-1/2	6	12-11/16	3-1/2	5	13/32	2-3/8	7-1/2	8	7/8	3/4	3/16
182T	8-7/8	5-3/4	15-3/16	4-1/2	4-1/2	13/32	2-15/16	9-5/8	9-1/2	1-1/8	3/4	1/4
[illegible]T	8-7/8	6 3/4	16-3/16	4-1/2	5-1/2	13/32	2-15/16	9-5/8	9-1/2	1-1/8	3/4	1/4
213T	10-1/2	7	18-9/16	5-1/4	5-1/2	13/32	3-3/4	11	11	1-3/8	1	5/16
215T	10-1/2	8-1/2	20-1/16	5-1/4	7	13/32	3-3/4	11	11	1-3/8	1	5/16
254T	12-1/8	10- 1/4	23-1/4	6-1/4	8-1/4	17/32	4-3/8	13	14	1-5/8	1-1/2	3/8
256T	12-1/8	12	25	6-1/4	10	17/32	4-3/8	13	14	1-5/8	1-1/2	3/8
284T	13-3/4	11-1/2	26-1/8	7	9-1/2	17/32	5	14-1/4	14-3/8	1-7/8	1-1/2	1/2
284TS	13-3/4	11-1/2	24-3/4	7	9-1/2	17/32	3-5/16	14-5/32	14-5/16	1-5/8	1-1/2	3/8
286T	13-3/4	13	27-11/16	7	11	17/32	5	14-1/4	14-3/8	1-7/8	1-1/2	1/2
286TS	13-3/4	13	26-1/4	7	11	17/32	3-5/16	14-5/32	14-5/16	1-5/8	1-1/2	3/8
324T	15-3/4	13-1/2	29-11/16	8	10-1/2	21/32	5-5/8	16-3/8	17	2-1/8	2	1/2
324TS	15-3/4	13-1/2	28-3/16	8	10-1/2	21/32	3-7/8	16-3/8	16-3/4	1-7/8	2	1/2
326T	15-3/4	15	31-3/16	8	12	21/32	5-5/8	16-3/8	17	2-1/8	2	1/2
326TS	15-3/4	15	29-11/16	8	12	21/32	3-7/8	16-3/8	16-3/4	1-7/8	2	1/2
364T	17-3/4	14-1/4	32-1/8	9	11-1/4	21/32	6-11/32	18-3/8	19-1/8	2-3/8	3	5/8
364TS	17-3/4	14-1/4	30	9	11-1/4	21/32	3-7/8	18-9/32	18-9/16	1-7/8	3	1/2
365T	17-3/4	15-1/4	33-1/8	9	12-1/4	21/32	6-11/32	18-3/8	19-1/8	2-3/8	3	5/8
365TS	17-3/4	15-1/4	31	9	12-1/4	21/32	3-7/8	18-9/32	18-9/16	1-7/8	3	1/2
404T	19-3/4	15-1/4	36-1/2	10	12-1/4	13/16	7-5/8	20-1/2	21-1/2	2-7/8	3	3/4
405T	19-3/4	16-3/4	38	10	13-3/4	13/16	7-5/8	20-1/2	21-1/2	2-7/8	3	3/4
405TS	19-3/4	16-3/4	35	10	13-3/4	13/16	4-3/8	20-7/16	20-7/8	2-1/8	3	1/2
444T	22	17-1/2	43-7/8	11	14-1/2	13/16	8-7/8	22-3/4	23-1/2	3-3/8	3	7/8
444TS	22	17-1/2	40-1/8	11	14-1/2	13/16	5	22-3/4	23-1/2	2-3/8	3	5/8
445T	22	19-1/2	45-7/8	11	16-1/2	13/16	8-7/8	22-3/4	23-1/2	3-3/8	3	7/8
445TS	22	19-1/2	42-1/8	11	16-1/2	13/16	5	22-3/4	23-1/2	2-3/8	3	5/8
447T	22	23	49-3/8	11	20	13/16	8-7/8	22-3/4	23-1/2	3-3/8	3	7/8
447TS	22	23	45-5/8	11	20	13/16	5	22-3/4	23-1/2	2-3/8	3	5/8
[illegible]T	22	28	55-1/8	11	25	13/16	8-5/8	24-1/8	26-1/8	3-3/8	3-1/2	7/8
449TL	22	28	57-1/8	11	25	13/16	10-5/8	24-1/8	26-1/8	4-3/8	3-1/2	1
449TS	22	28	51-3/8	11	25	13/16	4-7/8	24-1/8	26-1/8	2-3/8	3-1/2	5/8

GENERAL INSTALLATION, OPERATION & MAINTENANCE INSTRUCTIONS

SAFETY FIRST

High voltage and rotating parts can cause serious or fatal injury. Safe installation, operation, and maintenance must be performed by qualified personnel. Familiarization with and adherence to NEMA MG2, the National Electrical Code, and local codes is recommended. It is important to observe safety precautions to protect personnel from possible injury. Personnel should be instructed to:

1. Avoid contact with energized circuits or rotating parts.
2. Disconnect and lock out all power sources before initiating any maintenance or repair.
3. Act with care in accordance with prescribed procedures in handling and lifting this equipment.
4. Be sure unit is electrically grounded in accordance with code requirements.
5. Be sure equipment is properly enclosed to prevent access by children or other unauthorized personnel in order to prevent possible accidents.
6. Be sure shaft key is fully captive before unit is energized.
7. Avoid contact with capacitors until safe discharge procedures have been completed.
8. Most units are shipped without oil. Always be sure oil lubricated units are filled with correct oil to proper level before operating.
9. Provide proper safeguards for personnel against rotating parts and applications involving high inertia loads which can cause overspeed.
10. Avoid extended exposure to equipment with high noise levels.
11. Be familiar with the equipment and read all instructions thoroughly before installing on equipment.

INSPECTION AND HANDLING

Inspect unit to make sure no damage has occurred during shipment. Check Nameplate for correct speed, horsepower, voltage, Hertz, and phase for conformance with power supply and equipment. **WARNING:** Units should be lifted using all eyebolts or lugs if provided. These eyebolts or lugs are provided for lifting this unit only and must not be used to lift any additional weight. Lifting angle must not exceed 15° with shank of eyebolt. If not provided, eyebolts to be used must be per ASTM A489 or equivalent. All eyebolts must be securely tightened. Be careful not to touch overhead power lines with lifting equipment. Failure to observe this warning may result in serious personal injury or property damage.

STORAGE

Units should be stored indoors, in a clean, dry location. Winding should be protected from excessive moisture absorption. **NOTE:** If motors are to be stored for over one year, refer to U.S. Electrical Motors. If gear and belt transmission units are to be stored for over six months, refer to U.S. Electrical Motors.

LOCATION

Units should be located in a clean, well-ventilated area for maximum life. **WARNING:** Units should be located in a suitable enclosure to prevent access by children or other unauthorized personnel to prevent possible accidents.

INSTALLATION / MOUNTING

Mount units on a firm, flat surface sufficiently rigid to prevent vibration.

Drive belts and chains should be within recommended limits of tightness. Couplings should be properly aligned and balanced. For drive recommendations, refer to drive or equipment manufacturers or U.S. Electrical Motors. For application of drive equipment, refer to NEMA MG1.

Motors have been dynamically balanced using a half key the same length as the full key shipped with the motor. If pulley length is less than this key length, rework long key by removing one-half of excess length between pulley and end of key to maintain balance.

Do not restrict motor ventilation. Unless otherwise specified on nameplate, motor is designed for operation in accordance with NEMA MG1 "Usual Service Conditions" which states an ambient temperature range of 0-40°C (32-104°F). Standard grease lubricated units are suitable for operation within this temperature range, special lubricants may be required for ambient temperatures outside of the range. **NOTE:** motors operating under rated load and allowable ambient conditions may feel hot when touched; this is normal and should not be cause for concern. When in doubt, measure frame surface temperature and confer with nearest office.

If unit appears wet, and / or has been stored in a damp location, dry out thoroughly and check for adequate insulation resistance to ground before operating.

WARNING: Guards should be provided for all exposed rotating parts to prevent possible personal injury. Keep fingers and foreign objects away from ventilation and other openings. Applications involving HIGH INERTIAL LOADS may damage equipment due to motor overspeed during coast down. Such applications should be referred to U.S. Electrical Motors.

CAUTION: Do not force drive coupling or other equipment onto shaft, as bearing damage may result.

POWER SUPPLY AND CONNECTIONS

The power supply must agree with values on Nameplate. Terminal voltage should not vary more than ±10% of Nameplate voltage at rated frequency. Unbalanced line voltage, even a small amount, will cause overheating. Do not exceed the continuous rated operating current on the Nameplate. Starting controls and overload protection should be properly sized in accordance with the National Electrical Code and the control manufacturer's recommendations.

Motor connections should be made by following instructions on connection diagram. Determine direction of rotation before connecting driven equipment. Note direction of rotation label if supplied. Rotation may be reversed on three phase motors by interchanging any two line connections. On two phase motors, interchange A-1 and A-2; and on single phase motors interchange leads per connection diagram on motor. Wiring of units, controls, and grounding shall be in accordance with local and National Electrical Code requirements. **WARNING:** Failure to properly ground unit may cause serious injury to personnel. Where unexpected starting could be hazardous to personnel, do not use automatic reset starting devices.

OIL LUBRICATION

Most oil lubricated units are shipped without oil. Add oil of the correct viscosity for the ambient temperature, per Nameplate on unit, to proper level.

M[illegible]certain an oil with mild EP additives is used on wormgear units.

Refer to Nameplate or Lubrication Instruction Plate for oil viscosity and oil change interval. **WARNING:** For applications in the food and drug industry (including animal food), consult the petroleum supplier for lubricants that are acceptable to the Food and Drug Adminstration and other governing bodies.

MAINTENANCE

Inspect units at regular intervals. Keep units clean and ventilation openings clear of dust, dirt or other debris. Lubricate units per this operating instruction folder and instruction plate on unit. Excessive lubrication may damage the unit. Do not over grease! **WARNING:** Disconnect all power sources to the unit and discharge all parts which may retain an electrical charge before attempting any maintenance or repair. Screens and covers must be maintained in place when unit is in operation. Motors for use in hazardous locations - Class I & II Installation: Repairs of these motors must be made by the manufacturer or authorized service station approved by the manufacturer and U.L. to maintain the U.L. Listing. The U.L. Listing applies to the electrical motor only and not to the belt or gear transmissions or other devices that may be connected to the motor.

VARIDRIVE® UNITS

Do not turn control wheel while unit is not operating as this may cause damage to the unit. Handwheel position is a relative speed indication only. Use direct speed sensing accessory for precise speed indication. Units equipped with electric remote speed indicator accessory are not calibrated at the factory and must be calibrated at site. Refer to calibration instructions with meter.

VARIDRIVES equipped with splined shafts require monthly lubrication for 8 h[illegible]ay service, and semi-monthly for 24 hour/day service. (For complete in[illegible]tions for entire drive, refer to the lubrication instruction plate on unit.) Operate VARIDRIVE through its entire speed range weekly. **WARNING:** Do not force control wheel beyond speed limits shown on Nameplate. The mechanism and belt are designed for the rated speed and horsepower shown on the Nameplate. Operation beyond these limits may result in damage to the belt and mechanism and possible injury to personnel. The covers on the frame case must not be removed or left off while unit is in operation. Do not attempt to disassemble or repair the driven pulley discs as high spring force may be released, causing injury to personnel. Refer to authorized Service Center. Refer to VARIDRIVE Installation and Maintenance Manual for complete belt changing instructions.

For additional detailed information, request specific product installation and maintenance manual from U.S. Electrical Motors, St. Louis, MO 63136

RENEWAL PARTS AND WARRANTY SERVICE

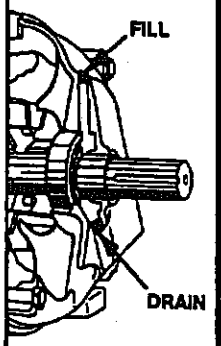
When inquiring for renewal parts, call the U.S. Electrical Motor Service Department (Memphis, Tennessee) or Parts Stocking Distributors. For warranty service call the nearest U.S. Electrical Motors Service Station. Give them complete nameplate data including ID number, etc.

LUBRICATION INSTRUCTIONS

Some small motors have sealed-for-life bearings which require no relubrication. Regreaseable bearings are shipped with a high quality, wide temperature range grease in the bearings.

Motors can be regreased by stopping the motor, removing drain plug and pumping new grease into fill hole. Run motor with drain plug removed until excess grease has been discharged (min. 10 mins.). Stop motor and replace drain plug.

Units that operate at speeds greater than 1800 RPM should be lubricated on a more frequent maintenance schedule depending on duty cycle. Use a low pressure grease gun and avoid overgreasing.



SUGGESTED REGREASING INTERVALS

SERVICE	MOTOR HORSEPOWER		
	UNDER 50	50-100	100 UP
A	3-5 Yrs.	2-4 Yrs.	2 Yrs.
B	2-4 Yrs.	1-1/2 Yrs.	1-1/2 Yrs.
C	1-2 Yrs.	1 Yr.	6 Mos.
D	4 Mos.	4 Mos.	3 Mos.

SERVICE SYMBOL	TYPE OF SERVICE
A	Infrequent operation or light duty in clean atmosphere.
B	8-16 Hrs/Day in clean, relatively dry atmosphere.
C	12-24 Hrs/Day, heavy duty, or if moisture is present.
D	Heavy duty in dirty, dusty locations; high ambients; moisture laden atmosphere; vibration.

Recommended Greases

Use the following greases or equivalent grease unless a special grease is specified on the nameplate.

MANUFACTURER	TRADE NAME
CHEVRON	SRI #2
SHELL	DOLIUM R

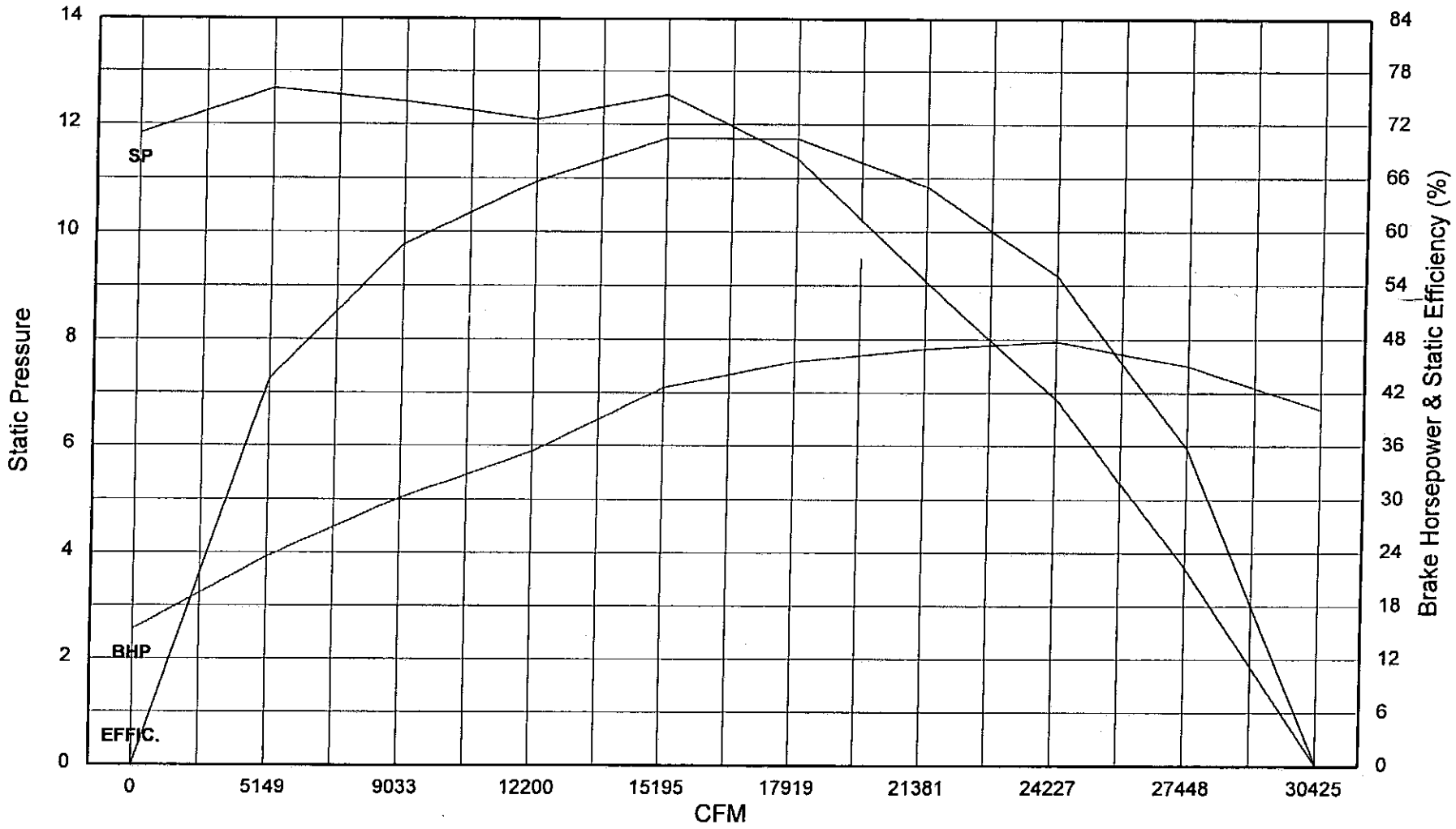
OFFICES	PHONE	FAX
CALIFORNIA 19877 Quiroz CT., Walnut, CA 91789	(909) 594-5470	(909) 594-2389
CONNECTICUT 326 West Main St., Milford, CT 06460	(203) 877-1762	(203) 877-2398
ILLINOIS 2050 South Carboy Road, Mt. Prospect, IL 60056	(708) 952-3500	(708) 952-0158
TENNESSEE 3363 Miac Cove, Memphis, TN 38118	(901) 794-5500	(901) 794-0741
TENNESSEE (PARTS) 3363 Miac Cove, Memphis, TN 38118	(901) 794-5500	(901) 366-4225
TEXAS 12068 Forest Gate Drive, Dallas, TX 75243	(214) 644-0470	(214) 644-0254
WORLD HEADQUARTERS 8100 West Florissant Avenue, P.O. Box 3946, St. Louis, MO 63136	(314) 553-2000	(314) 553-1156
MISSOURI		

U.S. ELECTRICAL MOTORS
DIVISION EMERSON ELECTRIC CO.
8100 WEST FLORISSANT AVENUE
P.O. BOX 3946
ST. LOUIS, MO 63136

Printed in the U.S.A.

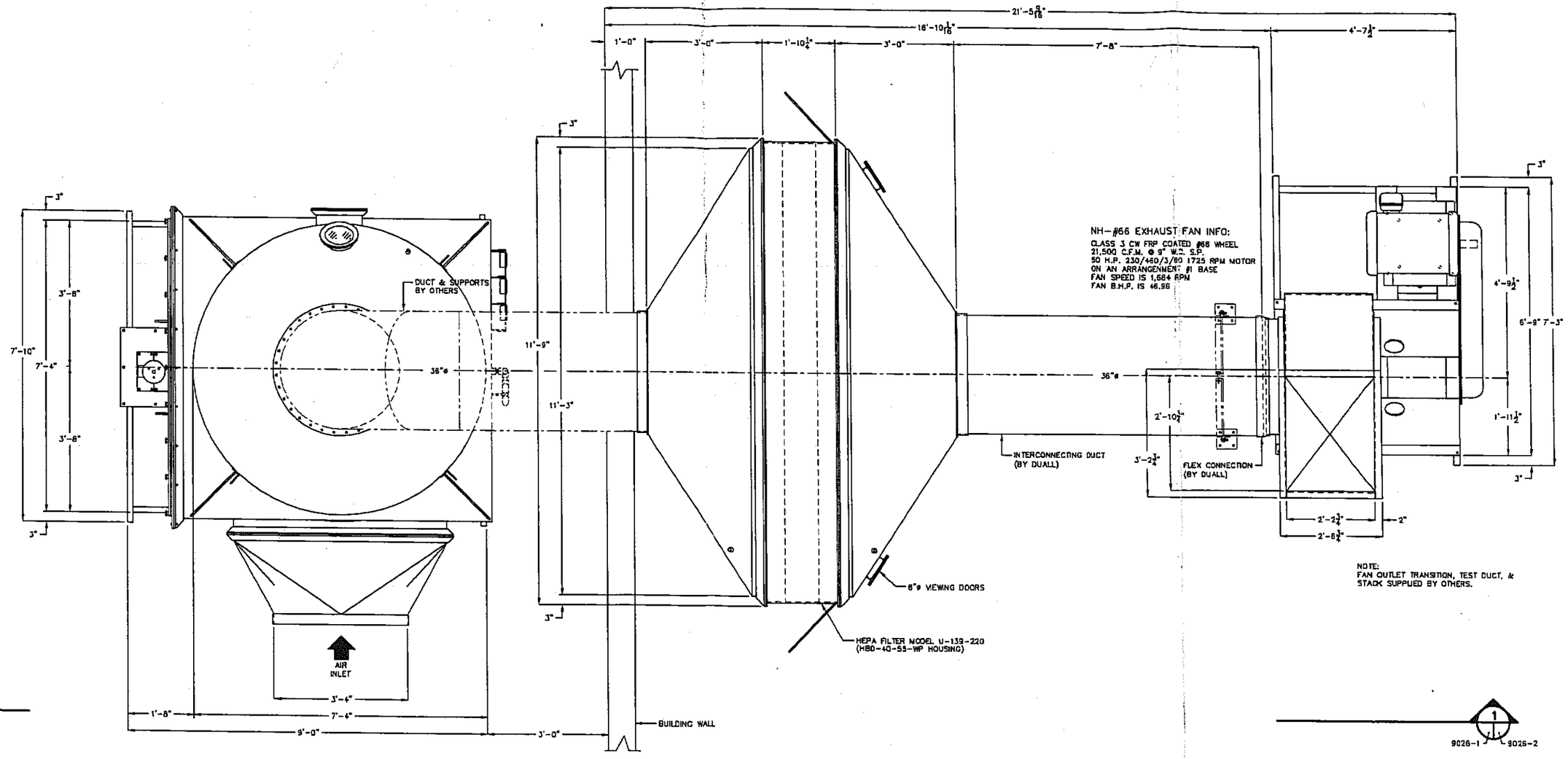
DUALL DIVISION NH-66

21,500 CFM @ 9" SP



1,684 RPM

Duall Job Number 9026



NOTE:
FAN OUTLET TRANSITION, TEST DUCT, & STACK SUPPLIED BY OTHERS.

1
9026-1 9026-2

PLAN VIEW

FABRICATION NOTES:

1. DUALL TO FABRICATE 36"ø HEPA FILTER TO FAN INTERCONNECTING DUCT FROM 1/4" TYPE 2 WHITE PVC MATERIAL. ALL OTHER DUCT IS TO BE SUPPLIED BY OTHERS.
2. ALL DUCT IS TO BE REINFORCED FOR 9" W.C. NEGATIVE STATIC PRESSURE.
3. ALL EQUIPMENT PADS, SUPPORTS, ETC. ARE TO BE SUPPLIED BY OTHERS.
4. ALL DUCT SUPPORTS ARE TO BE PROVIDED BY OTHERS.
5. ALL ELECTRICAL & PLUMBING REQUIREMENTS TO FAN & SCRUBBER ARE TO BE SUPPLIED BY OTHERS.
6. MAKE NO REPAIRS OR MODIFICATIONS WITHOUT CONTACTING YOUR SERVICE REPRESENTATIVE. WARRANTY MAY BE VOIDED.
7. PURCHASED PARTS CARRY THE WARRANTY OF THE ORIGINAL MANUFACTURER ONLY.
8. ELECTRIC CONTROL PANEL TO BE SHIPPED LOOSE & INSTALLED BY OTHERS.
9. ALLOWANCE FOR EXTERNAL PRESSURE LOSS IS 3" W.C.
10. FILTERS ARE TO HAVE VINYL-COATED SPACERS.

REVISION HISTORY			
1	3/17/98	W.S.	PER CUSTOMER APPROVAL DRAWINGS DATED 3/12/98
REV	DATE	BY	DESCRIPTION

MET PRO CORPORATION

Duall Division
1550 INDUSTRIAL DRIVE
OWOSSO, MI 48867

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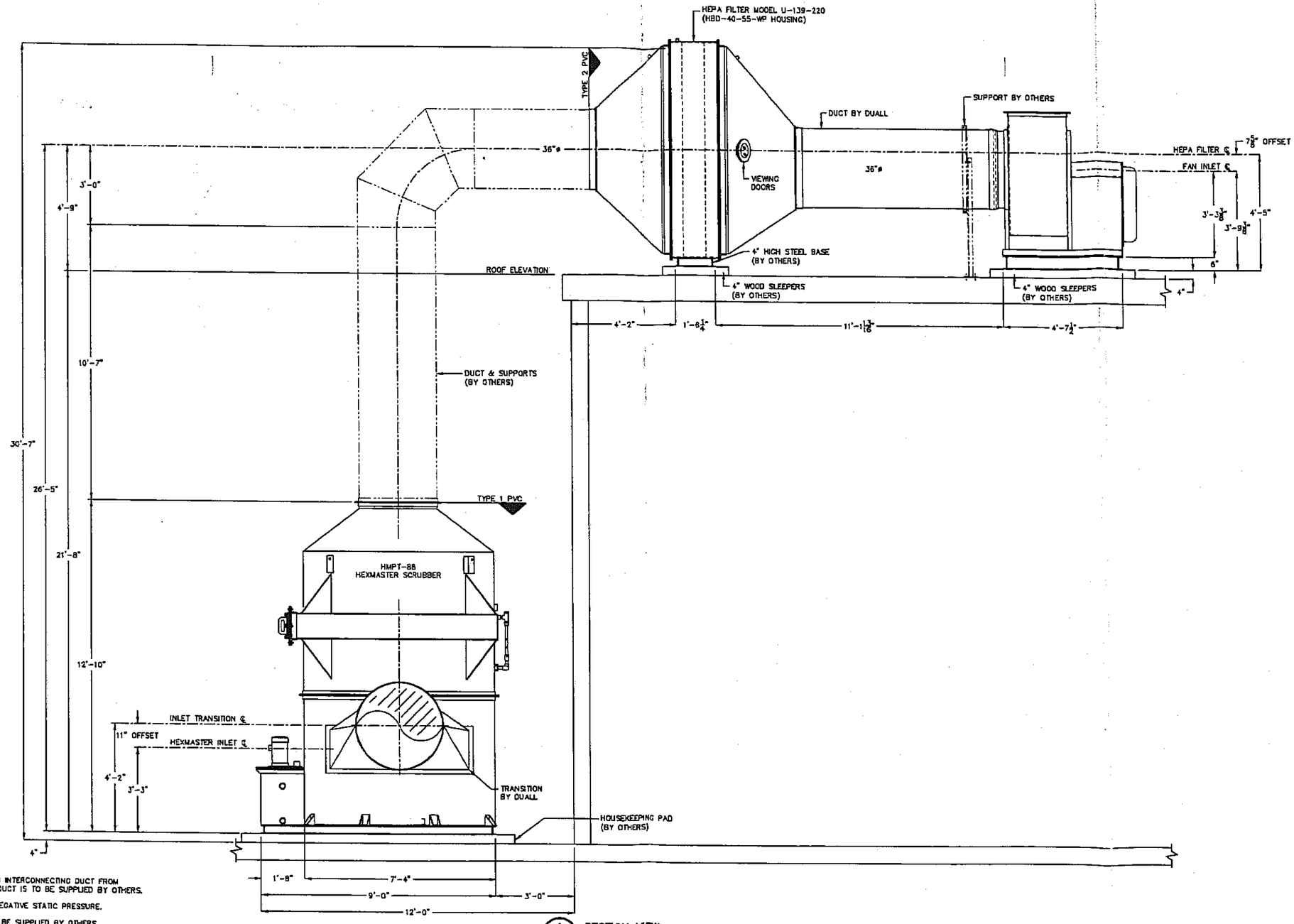
CUSTOMER INFORMATION			
PURCHASER	ELECTRONIC CHROME & GRINDING		
P.O.NO.	37543	SHEET 1 OF 8	
CUSTOMER	ELECTRONIC CHROME & GRINDING		

SYSTEM LAYOUT			
DRAWING INFORMATION			
P.M.	L. COLE	E.M.	DATE:
SCALE	3/4"=1'-0"	CAD SET-UP	
DRAWN	W.A.S.	DATE	2/6/98
DRAWING NUMBER	9026-1	REVISION	1



1 SECTION VIEW

9026-1 9026-2

FABRICATION NOTES:

1. DUALL TO FABRICATE 36"ø HEPA FILTER TO FAN INTERCONNECTING DUCT FROM 1/4" TYPE 2 WHITE PVC MATERIAL. ALL OTHER DUCT IS TO BE SUPPLIED BY OTHERS.
2. ALL DUCT IS TO BE REINFORCED FOR 9" W.C. NEGATIVE STATIC PRESSURE.
3. ALL EQUIPMENT PADS, SUPPORTS, ETC. ARE TO BE SUPPLIED BY OTHERS.
4. ALL DUCT SUPPORTS ARE TO BE PROVIDED BY OTHERS.
5. ALL ELECTRICAL & PLUMBING REQUIREMENTS TO FAN & SCRUBBER ARE TO BE SUPPLIED BY OTHERS.
6. MAKE NO REPAIRS OR MODIFICATIONS WITHOUT CONTACTING YOUR SERVICE REPRESENTATIVE. WARRANTY MAY BE VOIDED.
7. PURCHASED PARTS CARRY THE WARRANTY OF THE ORIGINAL MANUFACTURER ONLY.
8. ELECTRIC CONTROL PANEL TO BE SHIPPED LOOSE & INSTALLED BY OTHERS.
9. ALLOWANCE FOR EXTERNAL PRESSURE LOSS IS 3" W.C.
10. FILTERS ARE TO HAVE VINYL-COATED SPACERS.

REVISION HISTORY

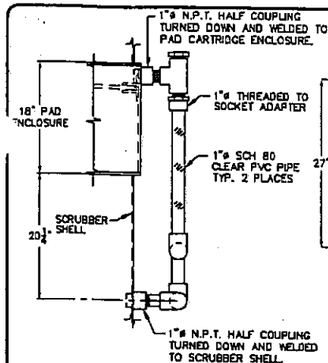
REV	DATE	BY	DESCRIPTION
1	3/17/98	W.S.	PER CUSTOMER APPROVAL DRAWINGS DATED 3/13/98

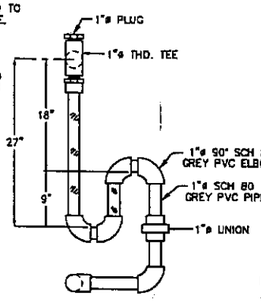
MET PRO CORPORATION

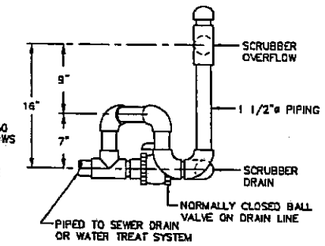
Duall Division
1550 INDUSTRIAL DRIVE
OWOSSO, MI 48867

SYSTEM SECTION VIEW

CUSTOMER INFORMATION		DRAWING INFORMATION		
PURCHASER: ELECTRONIC CHROME & GRINDING		P.M. L. COLE	E.M.	DATE:
		SCALE 1/2"=1'-0"	CAD SET-UP	
P.O.NO. 37543	SHEET 2 OF 6	DRAWN W.A.S.	DATE 2/9/98	
CUSTOMER: ELECTRONIC CHROME & GRINDING		DRAWING NUMBER 9026-2		REVISION 1

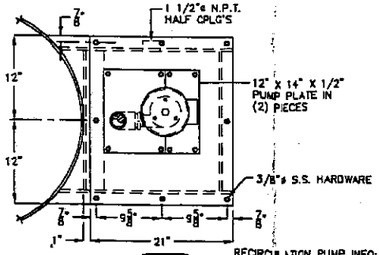


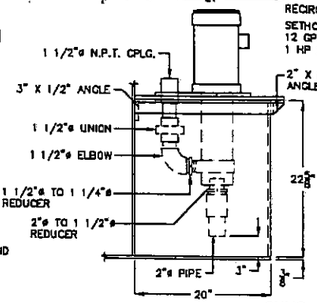




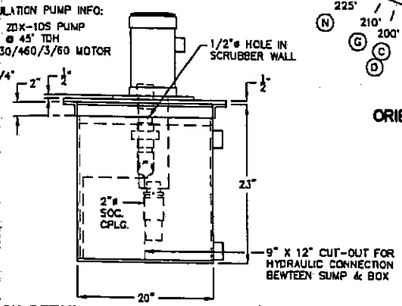
RECOMMENDED OVERFLOW TRAP DESIGN
(SUPPLIED & INSTALLED BY OTHERS)

NOTE:
TRAP MUST BE FULL PRIOR TO START-UP AND MAINTAINED FULL DURING OPERATION

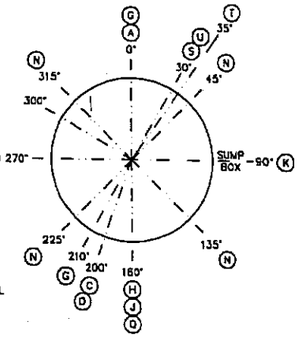




RECIRCULATION PUMP INFO:
SETHCO ZDX-10S PUMP
12 GPM @ 45' TDH
1 HP 230/460/3/60 MOTOR



SUMP BOX DETAIL

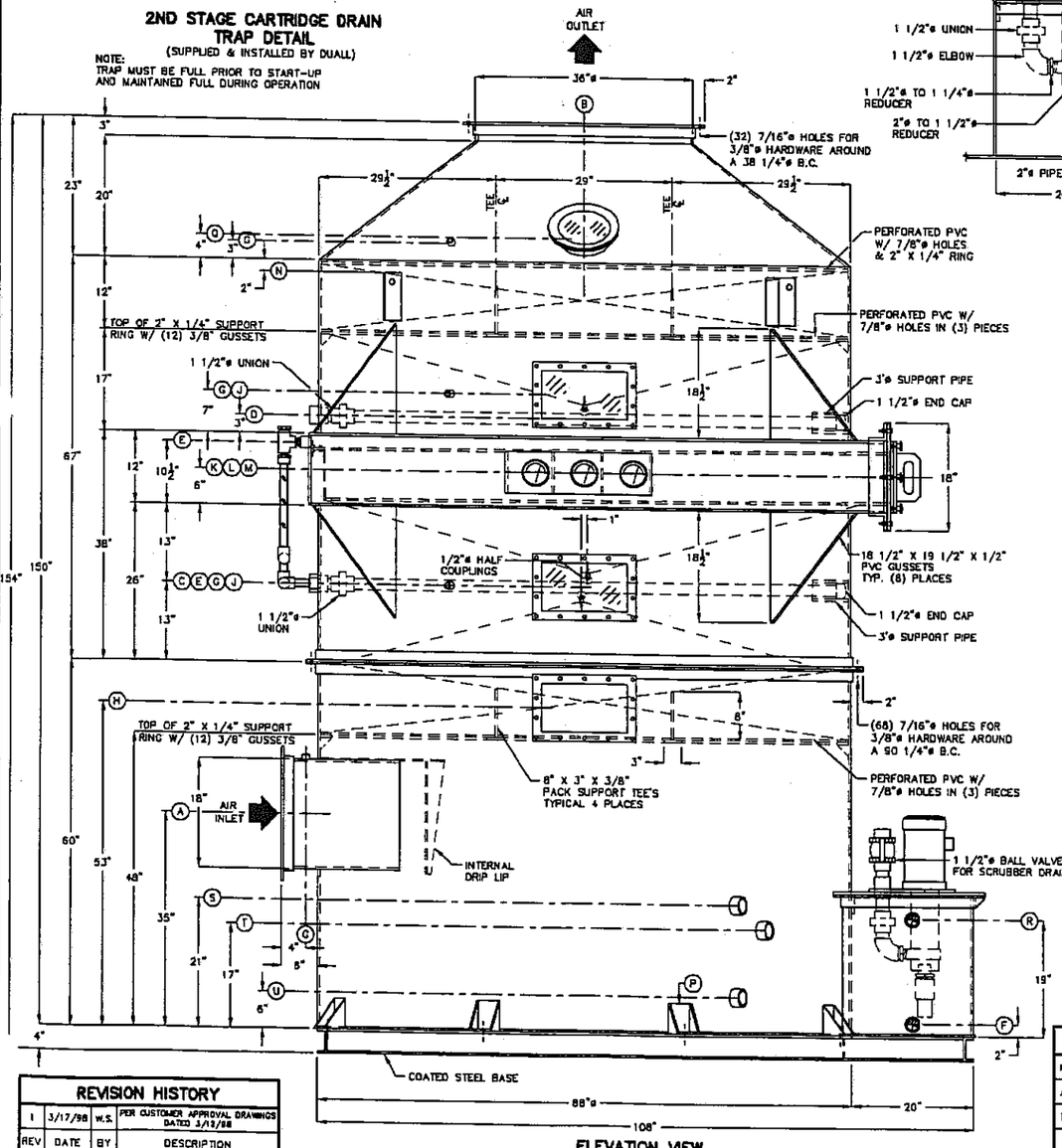


ORIENTATION

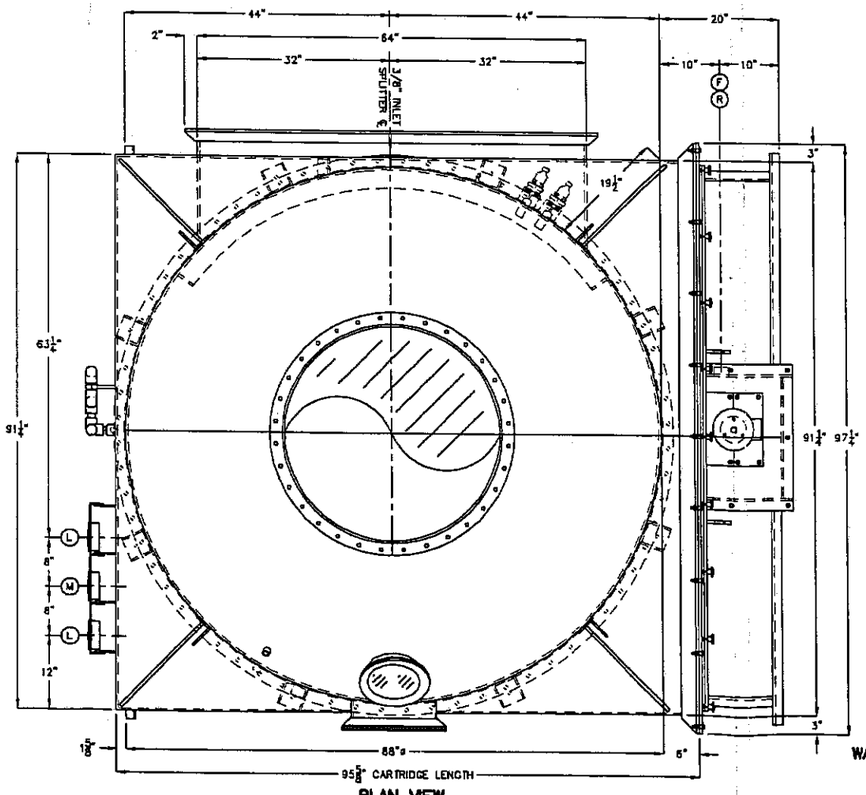
NOZZLE SCHEDULE				
MARK	QTY.	SIZE	TYPE	SERVICE
A	1	18" X 64"	2" ANGLE FLG.	AIR INLET W/ 3/8" SPLITTER
B	1	36"ø	2" ANGLE FLG.	AIR OUTLET
C	1	1 1/2"ø	N.P.T. FULL CLPG.	1ST & 2ND STAGE WASH DOWN INLET
D	1	1 1/2"ø	N.P.T. FULL CLPG.	3RD STAGE WASH DOWN INLET
E	2	1"ø	N.P.T. HALF CLPG.	CARTRIDGE DRAIN CONNECTIONS
F	1	1 1/2"ø	N.P.T. HALF CLPG.	SCRUBBER DRAIN (IN SUMP BOX)
G	4	1/2"ø	N.P.T. HALF CPLG.	PRESSURE TAPS (TRAPPED AS REQ'D)
H	1	8" x 14"	2" ANGLE FLG.	PACK REMOVAL DOOR (1/4" COVER)
J	2	8" x 14"	2" ANGLE FLG.	PLUMBING ACCESS DOOR (1/4" CLEAR)
K	1	12" X 91 1/4"	3" ANGLE FLG.	2ND STAGE MESH PAD REMOVAL DOOR
L	2	2002	DWYER	1ST & 3RD STAGE MAGNEHELIC GAUGE
M	1	2004	DWYER	2ND STAGE MAGNEHELIC GAUGE
N	4	3" X 4" X 8"	304 S.S.	LIFTING LUGS
P	8	LARGE	FORMED	HOLD DOWNS (LOCATED AT FAB)
Q	1	8 5/8"ø	2" ANGLE FLG.	3RD STAGE VIEWING DOOR (1/4" CLEAR)
R	1	1 1/2"ø	N.P.T. HALF CPLG.	OVERFLOW (IN SUMP BOX)
S	1	2"ø	N.P.T. HALF CPLG.	HARWIL L30-CR HIGH HIGH LEVEL SWITCH
T	1	2"ø	N.P.T. HALF CPLG.	HARWIL L30-CR HIGH LEVEL SWITCH
U	1	2"ø	N.P.T. HALF CPLG.	HARWIL L30-CR LOW LEVEL SWITCH

2ND STAGE CARTRIDGE DRAIN TRAP DETAIL
(SUPPLIED & INSTALLED BY DUALL)

NOTE:
TRAP MUST BE FULL PRIOR TO START-UP AND MAINTAINED FULL DURING OPERATION



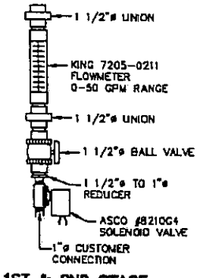
ELEVATION VIEW
(SEE PLAN FOR TRUE ORIENTATION)



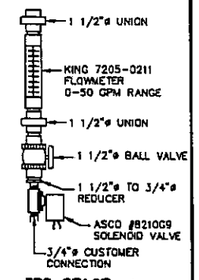
PLAN VIEW

FABRICATION NOTES:

1. (1) UNIT REQUIRED.
2. FABRICATE SHELL FROM 3/8", CONE FROM 1/4" TYPE I WHITE PVC. FABRICATE ALL INTERNALS FROM TYPE I GREY PVC.
3. 1ST & 3RD STAGE PACKING IS TO BE (1) (2"ø) JAEGER TRI-PACK, (88 CU. FT. TOTAL, 44 CU.FT. PER STAGE).
4. 2ND STAGE CONSISTS OF A MESH PAD. (SEE DRAWING 9026-4 FOR DETAILS).
5. SEE DRAWING 9026-5 FOR STEEL BASE DETAILS.
6. ALL GASKET MATERIAL IS TO BE SILICONE CAULK (BY DUALL).
7. ALL HARDWARE IS TO BE S.S. MATERIAL (BY DUALL).
8. ALL PIPING IS TO BE SCHEDULE 80 PVC MATERIAL.
9. WASHDOWN NOZZLES ARE BETE TF28-150 P.P. (3) REQ'D. (22 GPM @ 17.76 PSIG).
10. DUALL IS TO PRE-DRILL BODY FLANGES & SUPPLY GASKET & HARDWARE FOR FIELD ASSEMBLY OF UNIT.
11. MAKE NO REPAIRS OR MODIFICATIONS WITHOUT CONTACTING YOUR SERVICE REPRESENTATIVE. WARRANTY MAY BE VOIDED.
12. PURCHASED PARTS CARRY THE WARRANTY OF THE ORIGINAL MANUFACTURER ONLY.
13. SCRUBBER VESSEL IS DESIGNED FOR 9" W.C. OF NEG. S.P.
14. UNIT IS DESIGNED TO BE INSTALLED OUTDOORS.
15. ALL ACCESS DOORS EXCEPT 2ND STAGE CARTRIDGE DOOR & 3RD STAGE VIEWING DOORS ARE TO EXTEND 4" FROM VESSEL SHELL. CARTRIDGE DOOR EXTENDS 6", & 3RD STAGE DOOR EXTENDS 2 1/2".
16. FRESH WATER WASH DOWN ASSEMBLIES TO BE PROVIDED BY DUALL AS SHOWN BELOW. CUSTOMER IS TO PLUMB FRESH WATER TO ASSEMBLY & FROM ASSEMBLIES TO WASH DOWN CONNECTIONS ON UNIT. CUSTOMER IS TO MOUNT ASSEMBLIES AS REQUIRED.



1ST & 2ND STAGE WASHDOWN PIPING DETAIL



3RD STAGE WASHDOWN PIPING DETAIL

REVISION HISTORY			
1	3/17/98	W.S.	PER CUSTOMER APPROVAL DRAWINGS DATED 3/13/98
REV	DATE	BY	DESCRIPTION

OPERATING CONDITIONS		
MODEL	HMPT-88	WASHDOWN RATE 22 G.P.M. PER STAGE
ACFM	21,500	1ST & 2ND STAGE MINIMUM WASHDOWN CYCLE 1 MINUTE EVERY 8 HOURS
TEMP	AMBIENT	
ΔP.	3.5" W.C.	3RD STAGE MINIMUM WASHDOWN CYCLE 1 MINUTE ONCE A MONTH
SERVICE	CHROMIC ACID	

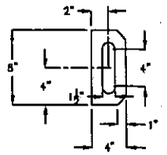
MET PRO CORPORATION

Duall Division
1550 INDUSTRIAL DRIVE
OWOSSO, MI 48867

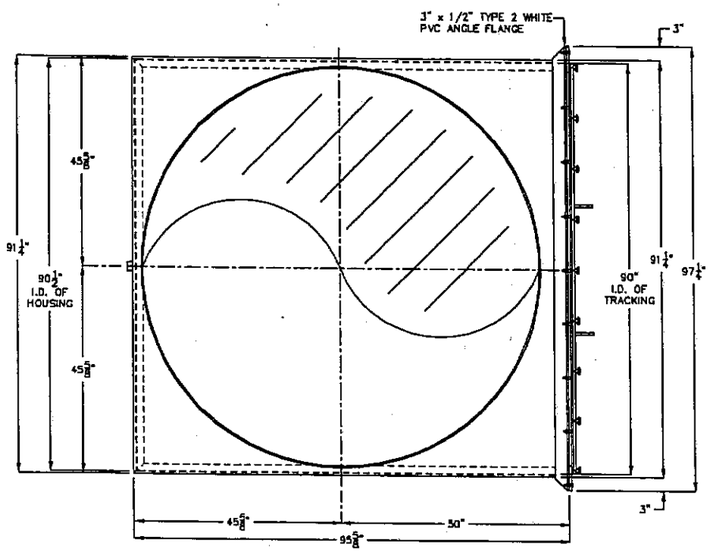
CUSTOMER INFORMATION			
PURCHASER	ELECTRONIC CHROME & GRINDING		
P.O.NO.	37543	SHEET 3 OF 8	
CUSTOMER	ELECTRONIC CHROME & GRINDING		

HMPT-88 HEXMASTER SCRUBBER DETAIL

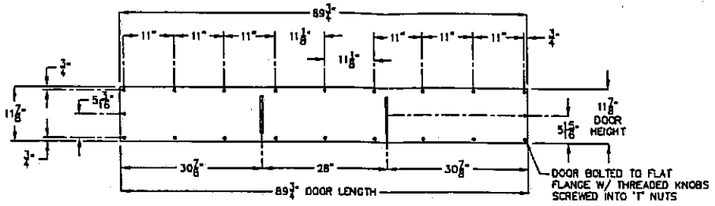
DRAWING INFORMATION			
P.M.	L. COLE	E.M.	DATE:
SCALE	1"=1'-0"	CAD SET-UP	
DRAWN	W.A.S.	DATE	2/6/98
DRAWING NUMBER	9026-3	REVISION	1



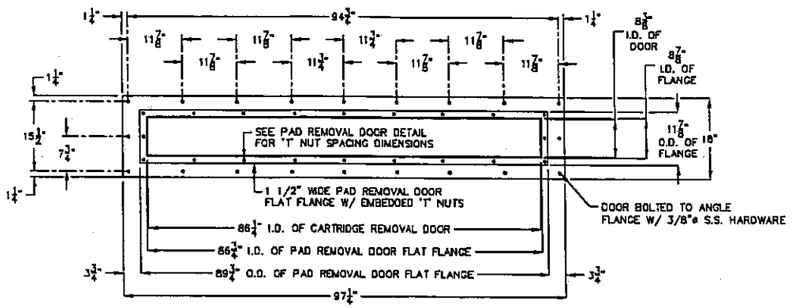
PAD REMOVAL DOOR HANDLE DETAIL
(2) REQUIRED FABRICATED FROM 1/2" TYPE 1 GREY PVC
SCALE 2"=1'-0"



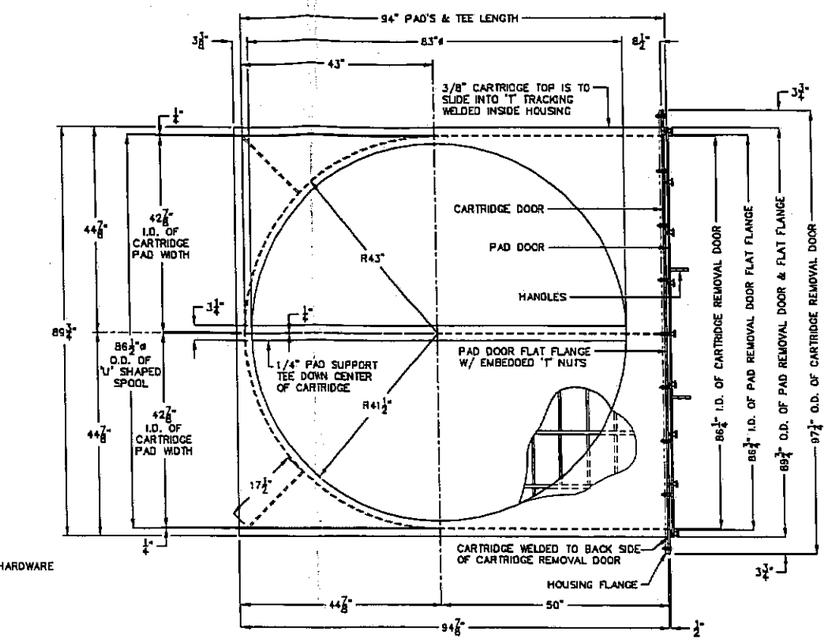
HOUSING PLAN VIEW
(SHOWN WITH REMOVAL DOORS BOLTED IN PLACE)



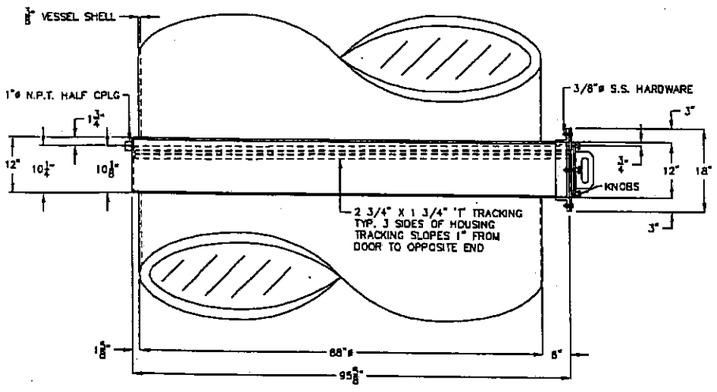
PAD REMOVAL DOOR DETAIL



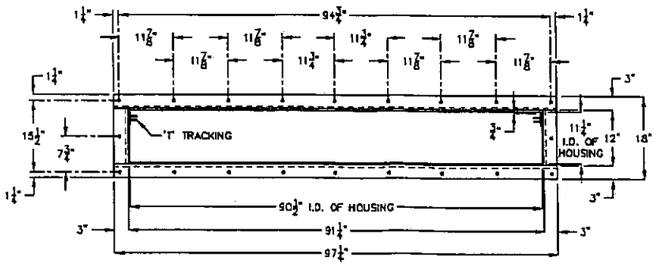
CARTRIDGE REMOVAL DOOR DETAIL
(SHOWN WITH PAD REMOVAL DOOR FLAT FLANGE WELDED IN PLACE)



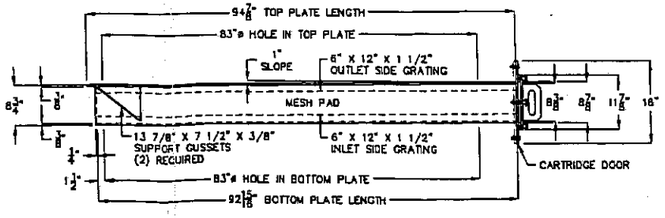
CARTRIDGE & DOORS PLAN VIEW



HOUSING ELEVATION
(SHOWN WITH REMOVAL DOORS BOLTED IN PLACE)



HOUSING FRONT ELEVATION



CARTRIDGE & DOORS ELEVATION VIEW

FABRICATION NOTES:

1. (1) CARTRIDGE REQUIRED.
2. FABRICATE CARTRIDGE FROM TYPE 1 GREY PVC MATERIAL.
3. FABRICATE DOORS & DOOR FLANGES FROM 1/2" TYPE 1 WHITE PVC MATERIAL.
4. PAD CONSISTS OF (22) LAYERS. (1) 16/96, (20) 8/96, & (1) 37/94. (INLET TO OUTLET) ATTACH 6" X 12" X 1 1/2" GRATING TO INLET & OUTLET SIDE OF PAD, PAD IS TO BE 'U' SHAPED IN (2) PIECES 94" LONG BY 42 7/8" WIDE W/ 43" RADIUS.

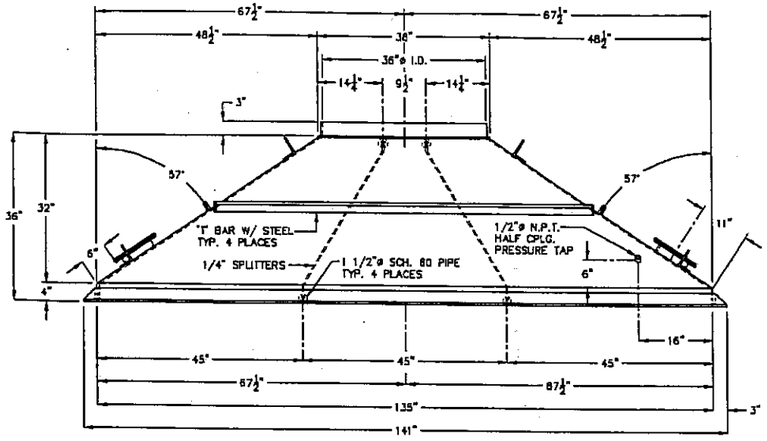
MET PRO CORPORATION

Duall Division
1550 INDUSTRIAL DRIVE
OWOSSO, MI 48867

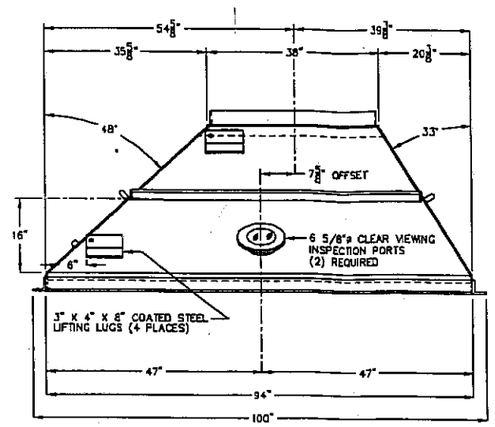
CUSTOMER INFORMATION			
PURCHASER: ELECTRONIC CHROME & GRINDING			
P.O. NO. 37543	SHEET 4 OF 8		
CUSTOMER: ELECTRONIC CHROME & GRINDING			

HMPT-88 HEXMASTER 2ND STAGE CARTRIDGE DETAIL

DRAWING INFORMATION			
P.M. L. COLE		E.M.	DATE
SCALE 3/4"=1'-0"		CAD SET-UP	
DRAWN W.A.S.		DATE 2/6/98	
DRAWING NUMBER 9026-4			REVISION



PLAN VIEW



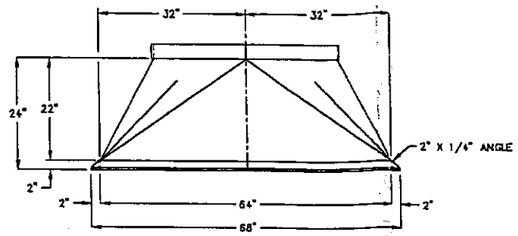
RIGHT ELEVATION

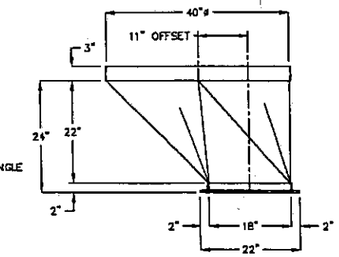
HEPA FILTER OUTLET TRANSITION DETAIL

SCALE - 3/4"=1'-0"

FABRICATION NOTES:

1. (1) REQUIRED.
2. FABRICATE FROM 3/8" TYPE 2 WHITE PVC MATERIAL.
3. DUALL IS TO PRE-DRILL TRANSITION TO FILTER INLET.
4. DUALL IS TO PROVIDE SILICONE GASKET FOR FIELD ASSEMBLY.
5. DUALL IS TO PROVIDE 3/8"ø S.S. HARDWARE FOR FIELD ASSEMBLY TO UNIT.
6. LIFTING LUGS ARE TO BE BOLTED TO TRANSITION W/ (3) 3/8"ø S.S. BOLTS.
   A. 8" X 12" X 3/8" MIN. REINFORCING PLATE IS TO BE WELDED TO INSIDE OF UNIT AT LUG POINTS.
   B. BOLTS ARE TO HAVE A PVC CAP WELDED OVER THEM ON THE INSIDE.



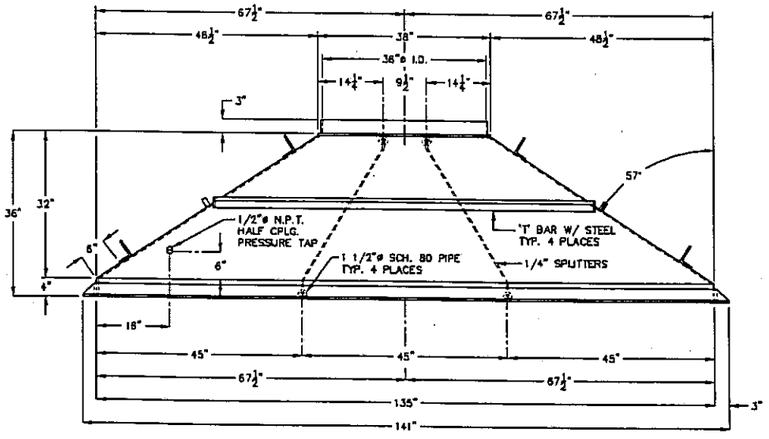


HMPT-88 INLET TRANSITION DETAIL

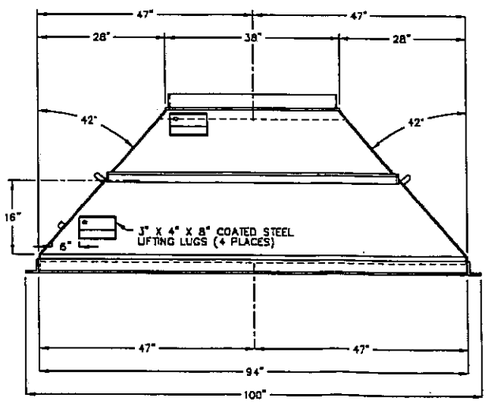
SCALE - 3/4"=1'-0"

FABRICATION NOTES:

1. (1) REQUIRED.
2. FABRICATE FROM 1/4" TYPE 1 WHITE PVC MATERIAL.
3. DUALL IS TO PRE-DRILL TRANSITION TO UNIT.
4. DUALL IS TO PROVIDE SILICONE GASKET FOR FIELD ASSEMBLY.
5. DUALL IS TO PROVIDE 3/8"ø S.S. HARDWARE FOR FIELD ASSEMBLY TO UNIT.



PLAN VIEW



RIGHT ELEVATION

HEPA FILTER INLET TRANSITION DETAIL

SCALE - 3/4"=1'-0"

FABRICATION NOTES:

1. (1) REQUIRED.
2. FABRICATE FROM 3/8" TYPE 2 WHITE PVC MATERIAL.
3. DUALL IS TO PRE-DRILL TRANSITION TO FILTER INLET.
4. DUALL IS TO PROVIDE SILICONE GASKET FOR FIELD ASSEMBLY.
5. DUALL IS TO PROVIDE 3/8"ø S.S. HARDWARE FOR FIELD ASSEMBLY TO UNIT.
6. LIFTING LUGS ARE TO BE BOLTED TO TRANSITION W/ (3) 3/8"ø S.S. BOLTS.
   A. 8" X 12" X 3/8" MIN. REINFORCING PLATE IS TO BE WELDED TO INSIDE OF UNIT AT LUG POINTS.
   B. BOLTS ARE TO HAVE A PVC CAP WELDED OVER THEM ON THE INSIDE.

REVISION HISTORY

REV	DATE	BY	DESCRIPTION
1	3/17/98	W.S	PER CUSTOMER APPROVAL DRAWINGS DATED 3/17/98

MET PRO CORPORATION

Duall Division
1550 INDUSTRIAL DRIVE
OWOSSO, MI 48867

CUSTOMER INFORMATION

PURCHASER: *ELECTRONIC CHROME & GRINDING*

P.O.NO. *37543* SHEET *6* OF *8*

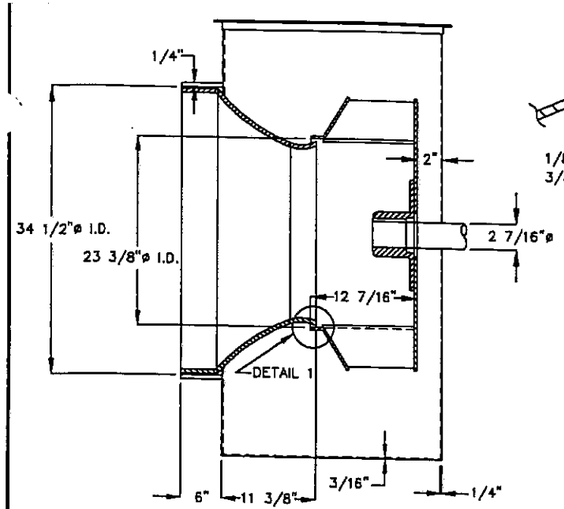
CUSTOMER: *ELECTRONIC CHROME & GRINDING*

TRANSITION DETAILS

DRAWING INFORMATION

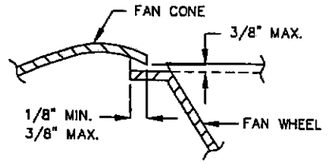
P.M.	L. COLE	E.M.	DATE
SCALE	3/4"=1'-0"	CAD SET-UP	
DRAWN	W.A.S.	DATE	2/9/98

DRAWING NUMBER *9026-6* REVISION *1*

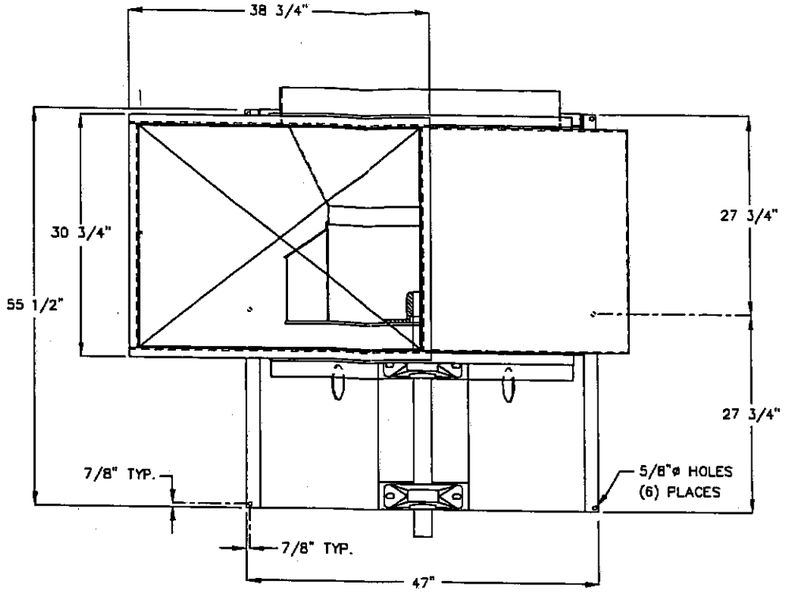


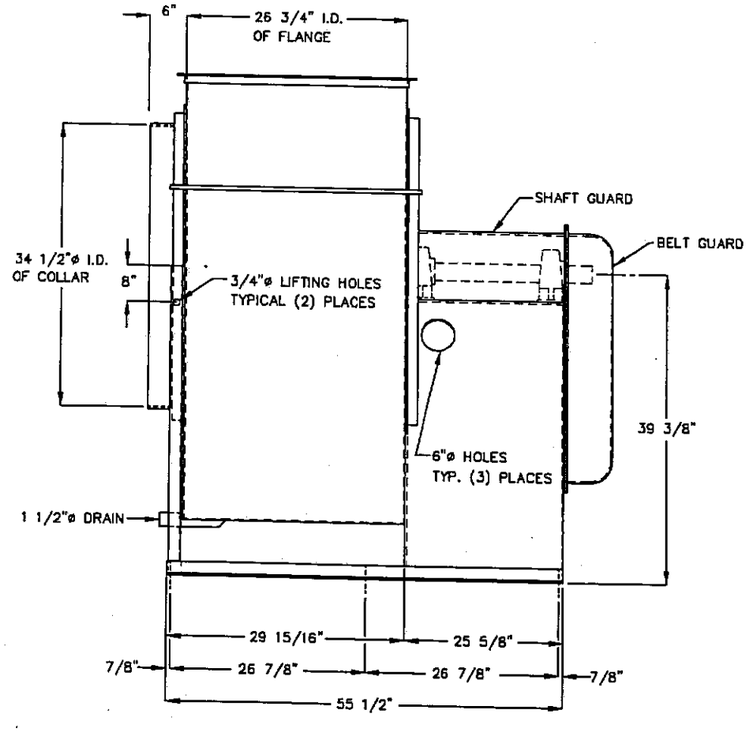
NOTE:

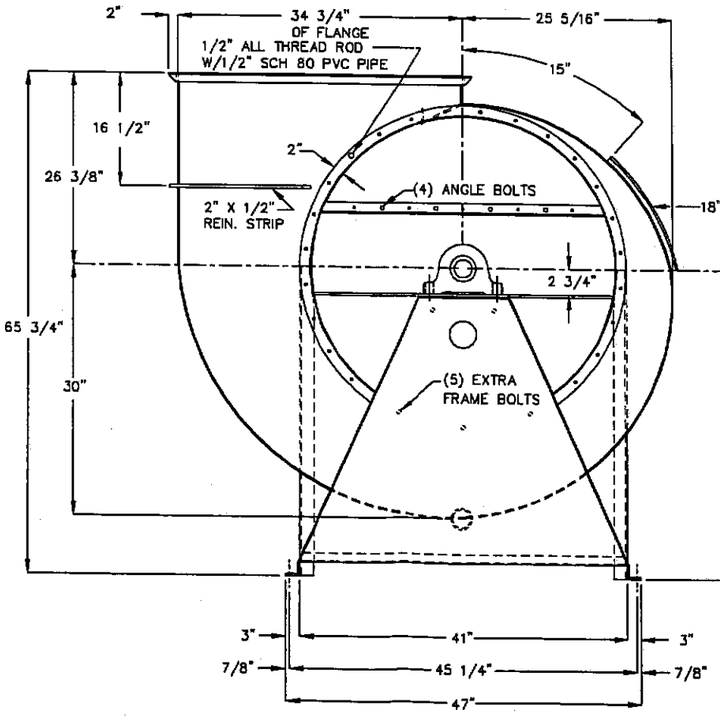
INLET CONE FASTENED W/ (6) 3/8"ø BOLTS.
BOLTS ARE TO HAVE A PVC CAP



DETAIL 1







NOTE:

ACCESS DOOR LOCATION IS FOR UPBLAST FANS. PLACEMENT WILL VARY WITH OTHER ROTATIONS SEE FAN ROTATION AT BOTTOM

MOTOR INFORMATION F212 **WHEEL INFORMATION**

MOTOR MODEL -- US Motor	WHEEL TYPE BI STEEL
230/460 V. 3 PH. 60 HZ.	COATING TYPE #222HT FLAKELINE
MOTOR FRAME 326T	WHEEL CLASS 3
MOTOR HP 50	ROTATION CW
MOTOR RPM 1,725	

DRIVE INFORMATION

FIXED X ADJUSTABLE	
BEARINGS FAFNIR, RAS 2 7/16"	
MOTOR: SHEAVES -- 4B5V90	
BUSHING -- B x 2 1/8"ø	
FAN: SHEAVES -- 4B5V94	
BUSHING -- B x 2 7/16"ø	
BELT(S) -- BX-120 (4)	

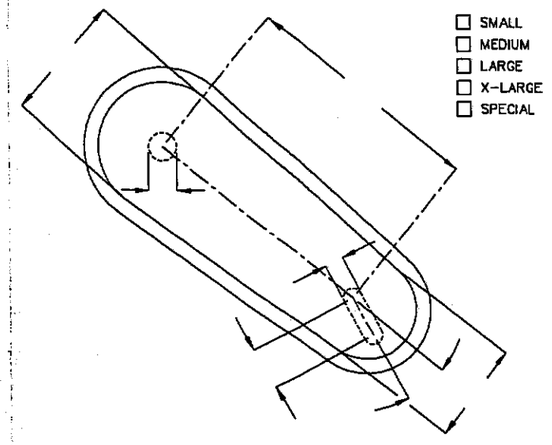
OPTIONAL EQUIPMENT

DRAIN	YES X NO
CLEAN OUT DOOR	X YES NO
INLET FLANGE	YES X NO
FLEXIBLE INLET	X YES NO
FLEXIBLE OUTLET	YES X NO
BIRD SCREEN	YES X NO
VIBRATION ISOLATORS	YES X NO
WEATHER COVER	YES X NO

NOTES:

(1) REQUIRED

SEE DRAWING 9026-8 FOR ARR. #1 BASE DETAIL

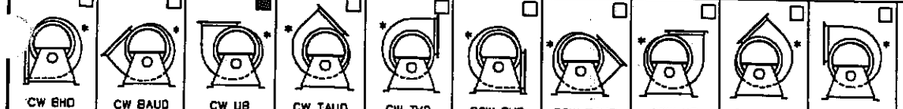


☐ SMALL
☐ MEDIUM
☐ LARGE
☐ X-LARGE
☐ SPECIAL

BELT GUARD DETAIL

BELT GUARD FABRICATION NOTES:

1. STANDARD BELT GUARD IS TO BE FABRICATED FROM PVC, FRP, OR STEEL MATERIAL W/ PVC BACKPLATE.
2. MANUFACTURING IS TO SELECT SIZE OF GUARD & FILL IN ALL DIMENSIONS OF GUARD.
3. GUARD IS TO RECIEVE A TOP COAT TO MATCH COLOR OF HOUSING.



DOWN BLAST DISCHARGES ARE AVAILABLE UPON REQUEST * REPRESENTS ACCESS DOOR LOCATION

NH-66 FAN SPECIFICATIONS			
CFM	21,500	ARRANGEMENT	#1
SP	9" W.C.	MATERIAL	TYPE II PVC
RPM	1,684	COLOR	WHITE
BHP	46.96	ROTATION	CW UPBLAST

MET PRO CORPORATION

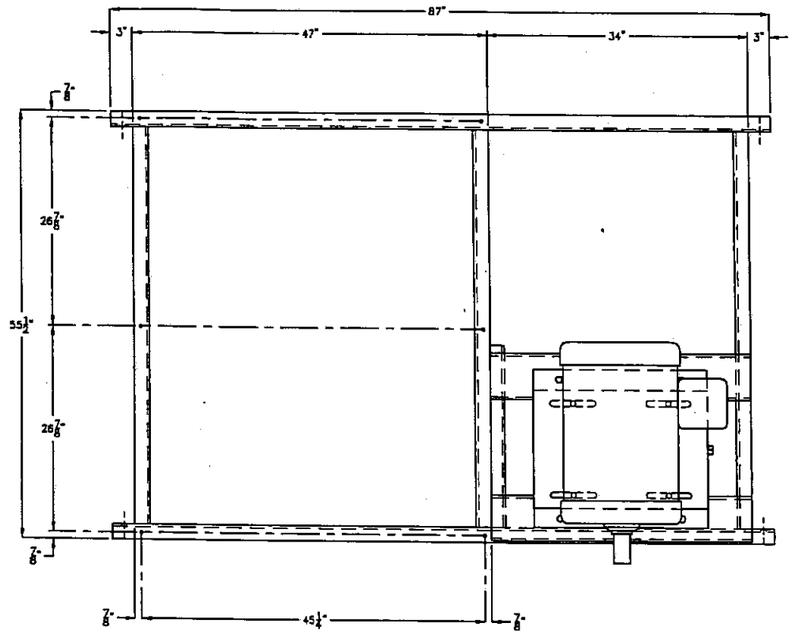
Duall Division
1550 INDUSTRIAL DRIVE
OWOSSO, MI 48867

CUSTOMER INFORMATION			
PURCHASER			
ELECTRONIC CHROME & GRINDING			
P.O.NO. 37543	SHEET 7 OF 8		
CUSTOMER			
ELECTRONIC CHROME & GRINDING			

NH-66 FAN DETAIL

DRAWING INFORMATION

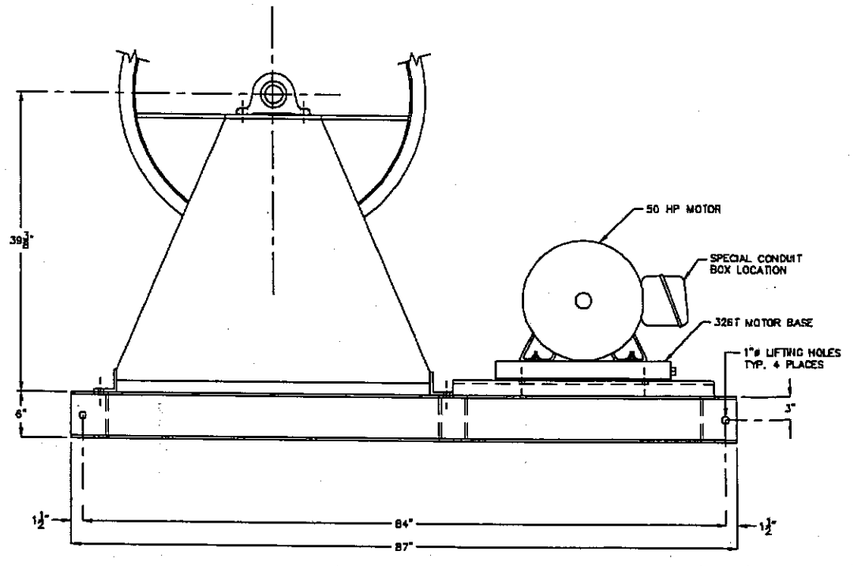
P.M.	L. COLE	E.M.	DATE:
SCALE	N.T.S.	CAD SET-UP	3/4"=1'-0"
DRAWN	W.A.S.	DATE	2/10/98
DRAWING NUMBER	9026-7	REVISION	1



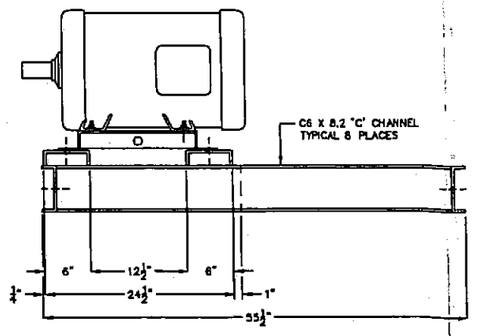
PLAN VIEW

FABRICATION NOTES:

1. (1) REQ'D, FABRICATE FROM CARBON STEEL MATERIAL.
2. AFTER COMPLETION SAND BLAST TO A WHITE FINISH.
3. COAT W/ GUARD COTE PRIMER & BLACK TOP COAT.



FRONT ELEVATION



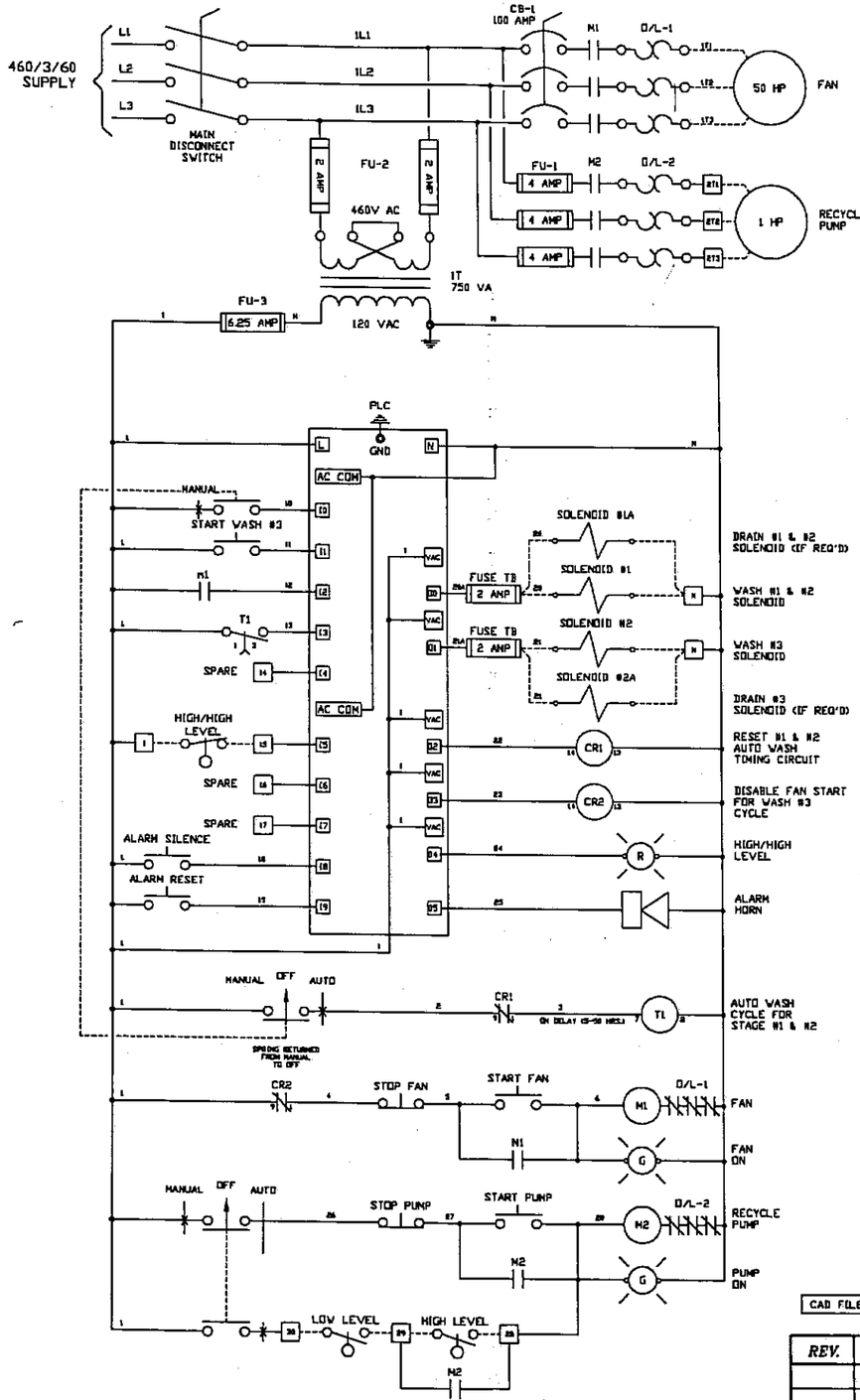
RIGHT ELEVATION

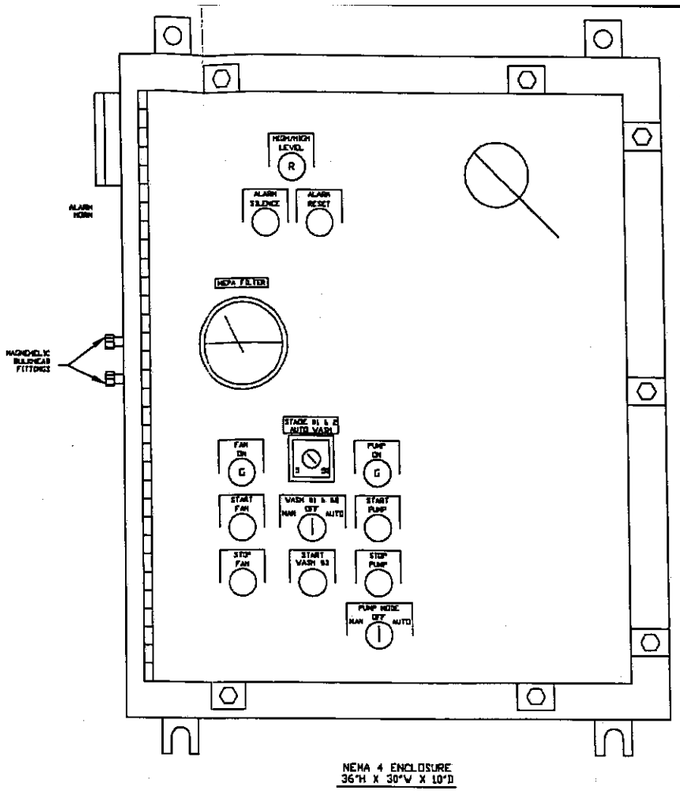
MET PRO CORPORATION

Duall Division
1550 INDUSTRIAL DRIVE
OWOSSO, MI 48867

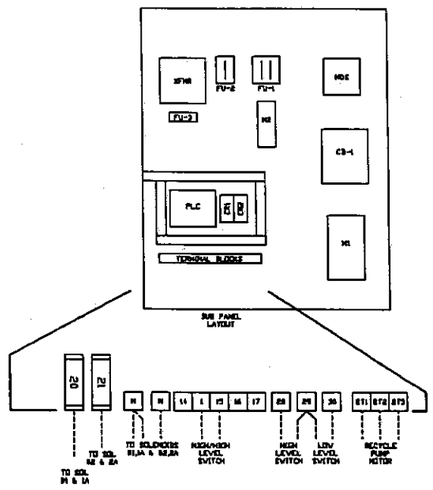
NH-#66 FAN & 50 HP ARRANGEMENT #1 BASE DETAIL

CUSTOMER INFORMATION		DRAWING INFORMATION	
PURCHASER: ELECTRONIC CHROME & GRINDING		P.M. L. COLE	E.M. DATE:
		SCALE 1 1/4"=1'-0"	CAD SET-UP
P.O.NO. 37543	SHEET 8 OF 8	DRAWN W.A.S.	DATE 2/10/98
CUSTOMER: ELECTRONIC CHROME & GRINDING		DRAWING NUMBER 9026-8	REVISION





NEMA 4 ENCLOSURE
36"H X 30"W X 10"D



PART	QTY	DESCRIPTION	MFR	PART NO.
1	1	ENCLOSURE	SAGINAW	SCE-36H30CLP
2	1	SUB-PANEL	SAGINAW	SCE-36P30
3	1	MAIN-DISCONNECT	ABB	OETL-NF200
4	1	CIRCUIT BREAKER	SQ-D	FAL34100
5	1	FAN-STARTER	ABB	BN75S-1F
6	1	FUSE HOLDER	BUSS	BM6033PQ
7	3	FUSE	BUSS	FNQ-4
8	1	FUSE HOLDER	BUSS	BM6032PQ
9	2	FUSE	BUSS	FNQ-2
10	1	TRANSFORMER	ACME	750 VA
11	1	FUSE HOLDER	MARATRHON	F30A1
12	1	FUSE	BUSS	FRN-6.25
13	1	PLC-UNIT	A-B	1761-L16AWA
14	7	PUSHBUTTON	SQ-D	9001-KR3UH13
15	2	RUN LIGHT	SQ-D	9001-KP1G9
16	1	TIMER	A-B	700-HRM12TA17
17	1	PANEL MTD. BRACKET	A-B	700-HN130
18	1	SELECTOR SWITCH	SQ-D	9001-KS63B-KA1
19	1	RED LIGHT	SQ-D	9001-KP1R9
20	1	MAN-OFF-AUTO SEL SW	SQ-D	9001-KS43BH13
21	2	CONTROL RELAY	IDEC	RH4B-U-120
22	2	SOCKET	IDEC	SH4B-05
23	1	HORN	EDWARDS	876-N5
24	1	MAGNEHELIC	DWYER	MODEL 2004
25	A/R	TB'S & FUSED TB'S	A-B	1492 SERIES

CAD FILE 236-5348

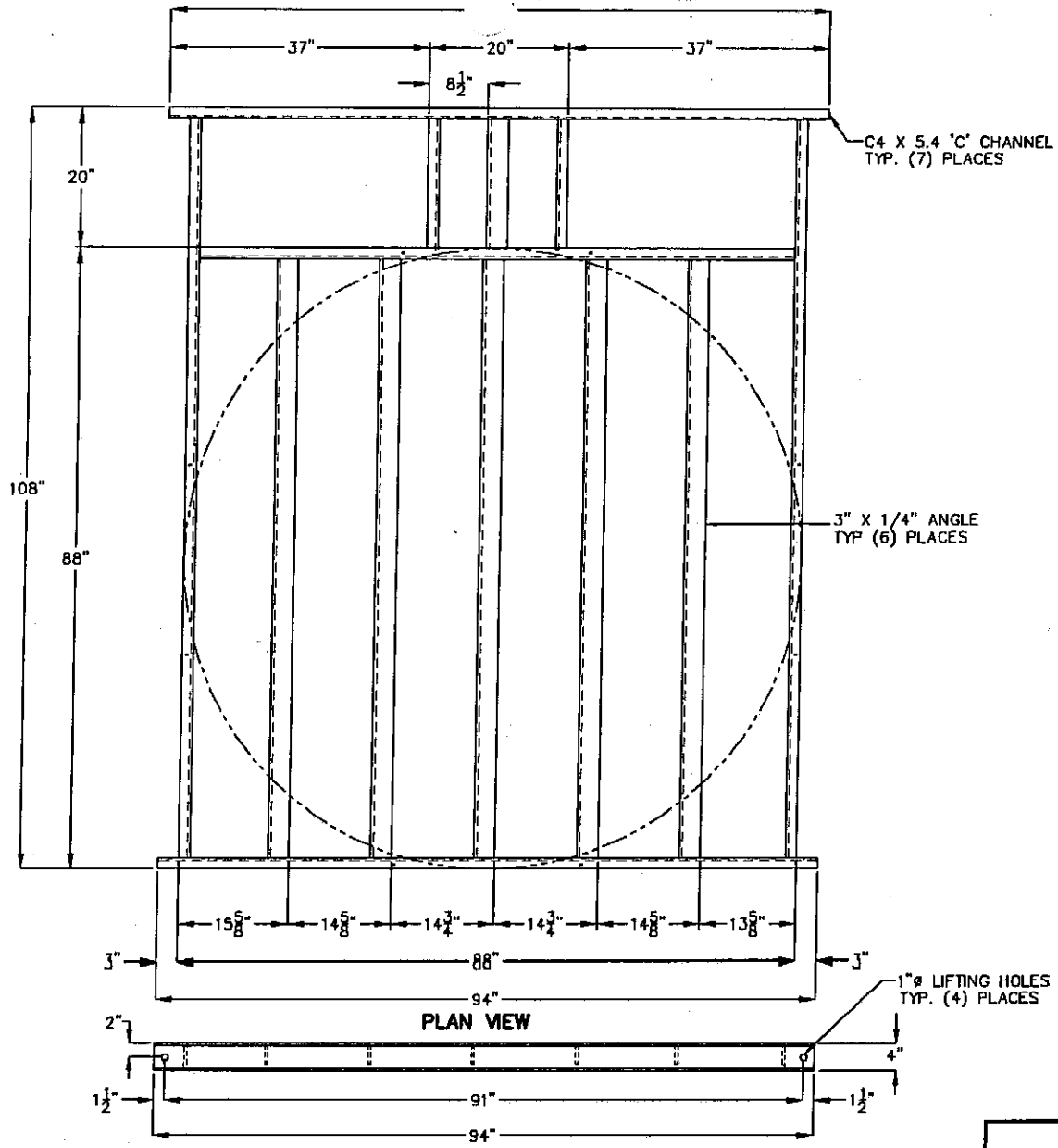
REV.	DESCRIPTION

MET PRO CORPORATION

Duall Division
1550 INDUSTRIAL DRIVE
OWOSSO, MI 48867

MET PRO CORPORATION

CUSTOMER INFORMATION		DRAWING INFORMATION			
PURCHASER: ELECTRONIC CHROME & GRINDING		P.M.	DATE:	E.M.	DATE:
		SCALE: N.T.S.		CAD SET-UP	
P.O.NO.: 37543		DRAWN		DATE	
CUSTOMER: ELECTRONIC CHROME & GRINDING		DRAWING NUMBER: 9026-1E			REVISION



FABRICATION NOTES:

1. (1) REQUIRED
2. FABRICATE FROM CARBON STEEL MATERIAL.
3. AFTER COMPLETION, SAND BLAST TO A WHITE FINISH.
4. COAT W/ GUARD COTE PRIMER & BLACK TOP COAT.

MET PRO CORPORATION

Duall Division
1550 INDUSTRIAL DRIVE
OWOSSO, MI 48867

CUSTOMER INFORMATION		DRAWING INFORMATION			
PURCHASER		P.M.	L. COLE	E.M.	DATE:
ELECTRONIC CHROME & GRINDING		SCALE	1"=1'-0"	CAD SET-UP	
P.O. NO. 37543	SHEET 6 OF 8	DRAWN	W.A.S.	DATE	2/9/98
CUSTOMER ELECTRONIC CHROME & GRINDING		DRAWING NUMBER	9026-5	REVISION	

HMPT-88 HEXMASTER STEEL BASE DETAIL

FLEXI-LINER™
FIELD REPAIR MANUAL
WELDING GUN AND PATCH KIT

WARRANTY CERTIFICATE
FOR FLEXI-LINER WELDING GUN

We warrant each welding gun for a period of six (6) months from the date of shipment. Should a unit prove to be defective within this period, it should be returned to Flexi-Liner™ Corporation, freight pre-paid. The unit will be carefully examined and, if satisfied that the defect is due to faulty material or workmanship, be repaired free of charge.

Customer attempted repair automatically voids this warranty.

!!!Heating elements are excluded from this warranty!!!

Model #HHNO5

Date Of Sale __/__/__

Serial # _____

OPERATING INSTRUCTIONS FOR HHNo5

The HHNO5 Electronic Welding Gun incorporates 3 main sections:

BACK SECTION: Back houses motor and includes electrical cord, carbon brushes and air intake screen are also located here.

MIDDLE SECTION: Plastic housing holds two control knobs: 1) heating stage switch for hot/cold temperature; 2) steplessly adjustable temperature control. Also contains blower.

BARREL/WELDING TIP: Contains heating element. Welding tip screws into end.

OPERATION

A Plug in electrical cord and switch on. Make sure that heating stage switch is in "off" position before plugging in tool.

B Depress right hand side (#1) of heating stage switch.

C Adjust temperature control knob according to material which you are welding. Temperature capacity is up to 650°C (approx. 1200°F).

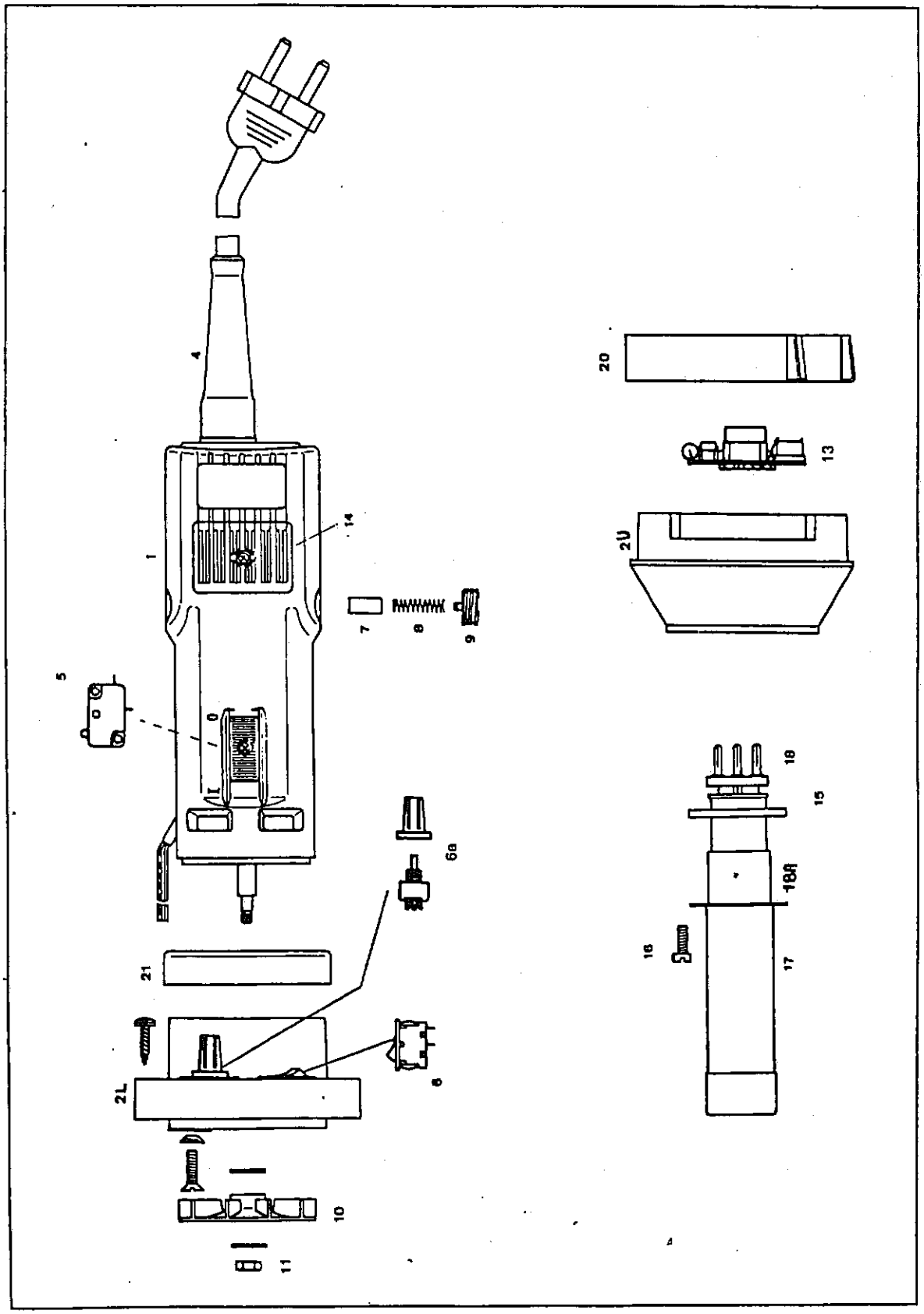
D Exact temperature setting will depend on several factors, therefore we will not recommend a precise temperature setting. Various environmental factors will influence your welding temperature such as: temperature of sheet and welding rod, welding speed, welding rod diameter, etc.

NOTE: Motor brushes should be checked regularly and replaced when necessary. **DO NOT** allow brushes to wear out completely as this may cause damage to the armature.

PARTS LIST

FLEXI-LINER HHNO5 HAND WELDING GUN

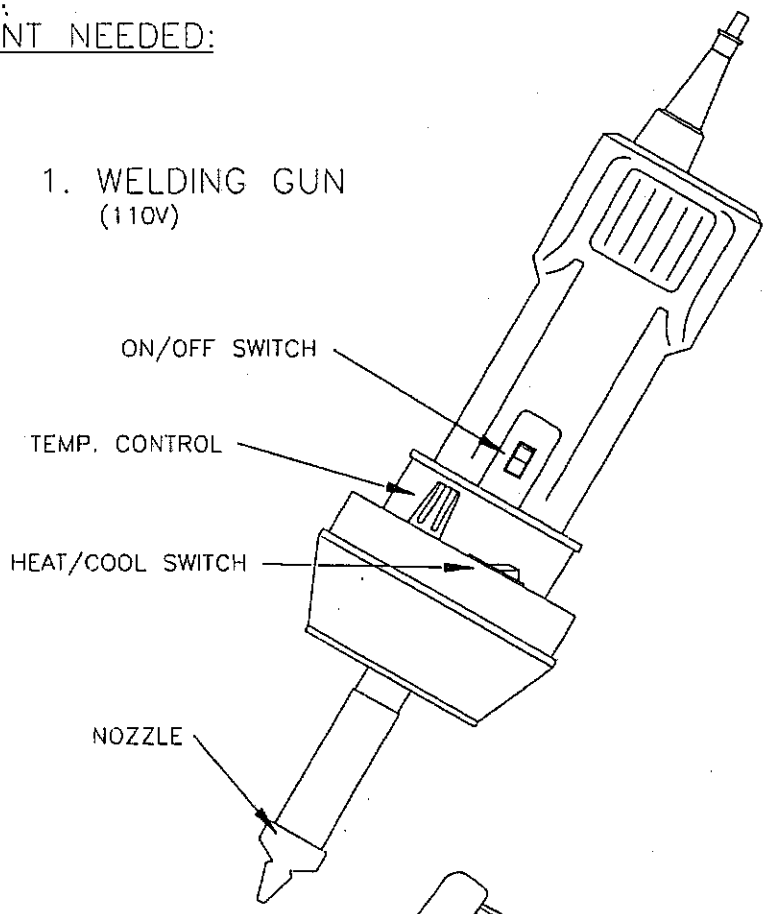
POS	DESCRIPTION
1	Motor, 110V
2U	Upper Housing
2L	Lower Housing
4	Rubber Sleeve For Cable
5	Main Switch
6	Heating Stage Switch
6A	Control Knob
7	Carbon Brushes (Set Of 2)
8	Springs For Brushes (Set Of 2)
9	Brush Holder Cover (Set Of 2)
10	Blower Wheel
11	Nut M5 With Washers (2)
13	Electronic Control Board, 110V
14	Air Intake Screen
15	Fiber Ring
16	Screw M4x10 (4)
17	Barrel
18	Heating Element 110V, 650+650W
18A	Insulating Tube
20	Rubber Stand
21	Rubber Gasket


4
1
14
5
7
8
9
6a
21
2L
6
10
11
20
13
2U
18
15
18A
16
17

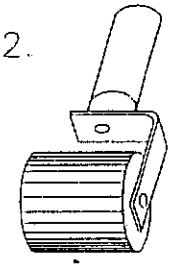
FIELD WELDING REPAIR

EQUIPMENT NEEDED:

1. WELDING GUN
(110V)

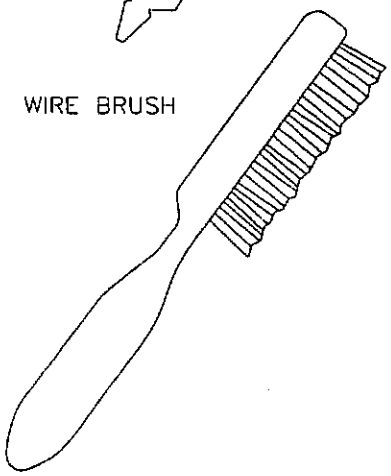


2.

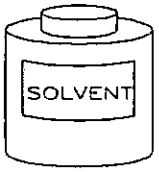


ROLLER WITH
SILICON RUBBER

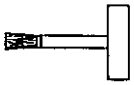
3. WIRE BRUSH



4. CLEANING SOLVENT



(SEE MSDS SHEET
FOR CAUTIONS
AND HANDLING)

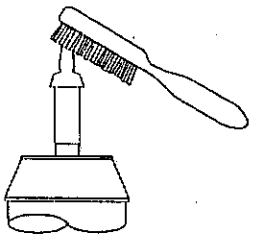


GLUE WITH
BUILT-IN BRUSH

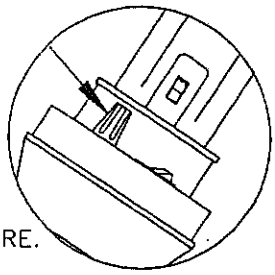
DRAWN BY: TRG		"THE LINER WITH EXPERIENCE"	CUSTOMER:
SCALE: NONE	DRAWING NUMBER	FLEXI LINER CORPORATION	FIELD REPAIR PROCEDURE FOR WELDING GUN
DATE: 08/24/92	WGREP1	165 ASPAN AVE.-AZUSA, CA 91702-4234 P.O. BOX 1070-AZUSA, CA 91702-1070 PHONE (818) 969-7702 PHONE (800) 423-4909 USA, CANADA, & MEXICO FAX (818) 969-7369 FAX (800) 356-4648 USA, CANADA, & MEXICO	P.O.# SO.#

REPAIR PROCEDURE

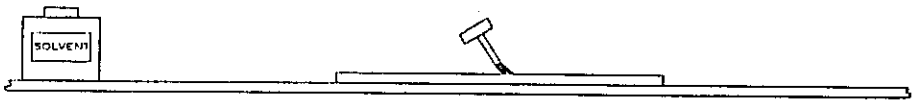
1. CREATE A CLEAN, SMOOTH SURFACE AROUND THE AREA TO BE REPAIRED.
2. CLEAN WELDING GUN NOZZLE WITH WIRE BRUSH.



3. TURN ON WELDING GUN AND ADJUST TEMPERATURE.

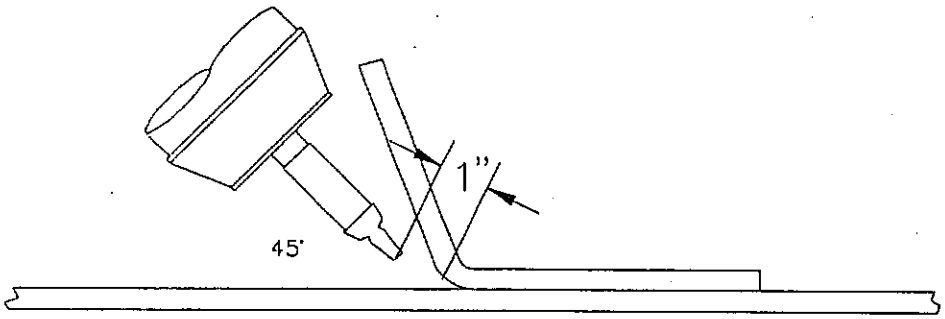


4. CUT PATCH AT LEAST 2" LARGER (ON ALL SIDES) THAN THE AREA TO BE REPAIRED. ROUND OFF ALL CORNERS. CLEAN PATCH AND LINER WITH WATER AND A CLEAN DRY CLOTH, THEN CLEAN WITH SOLVENT AND ALLOW SOLVENT TO EVAPORATE.



5. LAY PATCH OVER DAMAGED AREA.

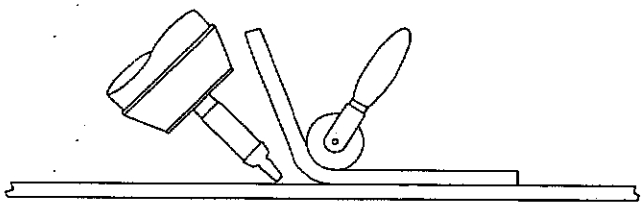
6. CHECK THAT WELDING GUN HAS REACHED THE DESIRED TEMPERATURE. PEEL PATCH BACK HALF WAY. SET GUN INTO LINER AT 45ø ANGLE AND ABOUT 1" AWAY FROM THE LINER.



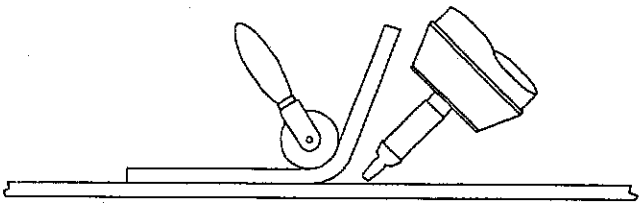
DRAWN BY: TRG		"THE LINER WITH EXPERIENCE"	CUSTOMER:
SCALE: NONE	DRAWING NUMBER WGREP2	FLEXI LINER corporation	FIELD REPAIR PROCEDURES FOR WELDING GUN
DATE: 08/25/92		165 ASPAN AVE.-AZUSA, CA 91702-4234 P.O. BOX 1070-AZUSA, CA 91702-1070 PHONE (818) 969-7702 PHONE (800) 423-4909 USA, CANADA, & MEXICO FAX (818) 969-7369 FAX (800) 356-4648 USA, CANADA, & MEXICO	P.O.# SO.#

REPAIR PROCEDURE–CONT.

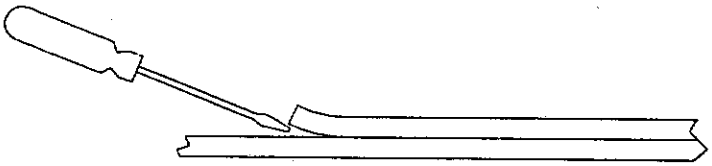
7. ROLL PATCH SLOWLY OVER LINER WHILE GUN MELTS LINER AND PATCH EVENLY.



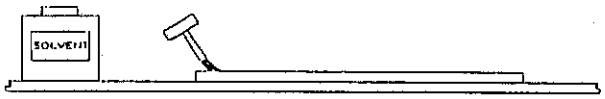
8. REPEAT AT OTHER SIDE.



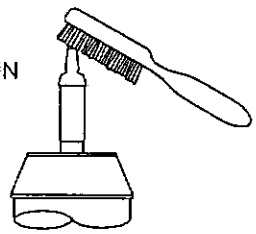
9. PEEL BACK ANY WEAK SPOTS WITH A SCREWDRIVER AND RESEAL.



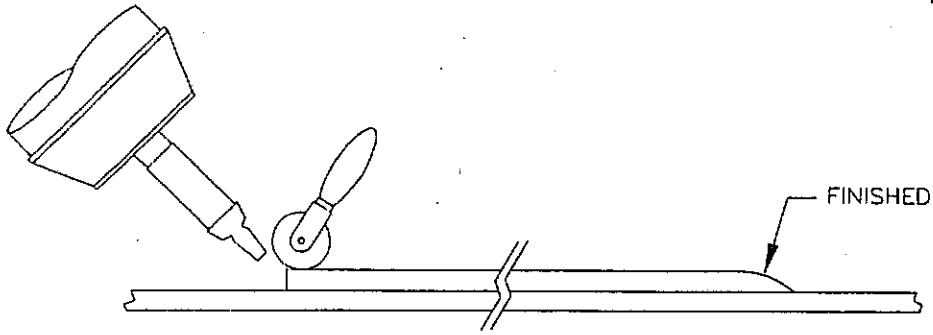
10. CLEAN AROUND THE EDGES WITH SOLVENT.



11. CLEAN THE WELDING GUN NOZZLE.



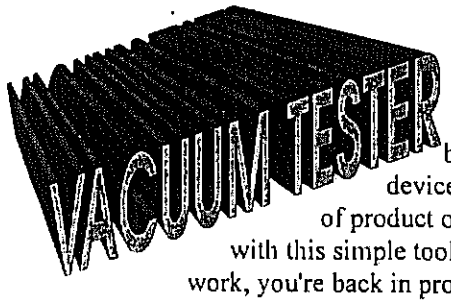
12. HOLD GUN 1" AWAY FROM PATCH AND ROLL EDGES DOWN.



13. DOUBLE CHECK ALL EDGES.

DRAWN BY: TRG		"THE LINER WITH EXPERIENCE" 165 ASPAN AVE.–AZUSA, CA 91702–4234 P.O. BOX 1070–AZUSA, CA 91702–1070 PHONE (818) 969-7702 PHONE (800) 423-4909 USA, CANADA, & MEXICO FAX (818) 969-7369 FAX (800) 356-4648 USA, CANADA, & MEXICO	CUSTOMER: FIELD REPAIR PROCEDURE FOR WELDING GUN
SCALE: NONE	DRAWING NUMBER WGREP3		P.O.# SO.#
DATE: 08/25/92			

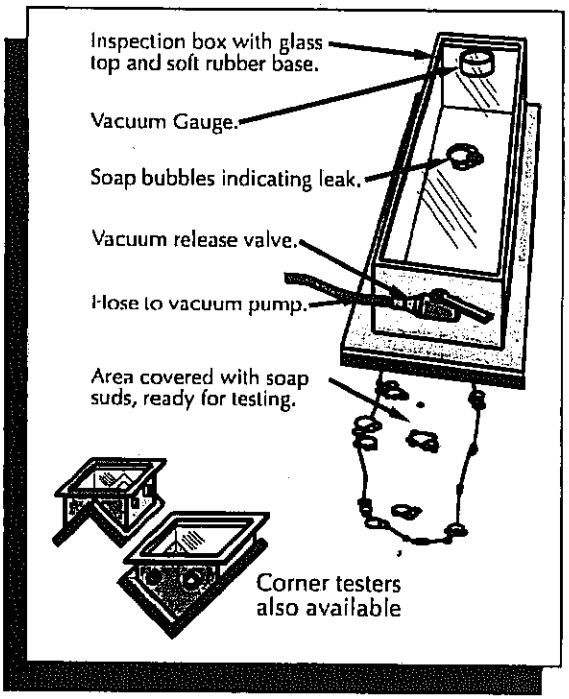
FLEXI-LINER



The Vacuum Tester enables instant detection of leaks, no matter how small. Imperfections can be located quickly by this simple, efficient, non-destructive tester. This time-saving device is light and portable for easy handling in field operations. Loss of product or damage to tanks can be costly as well as dangerous. However, with this simple tool, even the smallest leak can be found quickly; with a little repair work, you're back in production promptly. When your tank has a leak that you can't find easily, give us a call; we can overnight a Vacuum Tester to you and have you back in business fast. For more information, give us a call at (800) 423-4909.

OPERATING INSTRUCTIONS:

1. Electric motor operates on 110 volts, 60 cycles.
2. Using wide paint brush, paint the area to be tested generously with heavy soap suds.
3. Place Inspection Box over soaped area.
4. Turn 3-way cock to obtain vacuum. If gauge does not register a vacuum, apply pressure to inspection box to seal gasket over irregularities in the area. Vacuum will show bubbles over leaks.
5. Turn 3-way cock to admit air. Lift Inspection box and mark leak.
6. Place Inspection Box on next section to be tested. Do not slide Inspection Box; doing so will wear out gasket.
7. After testing, perform repairs on leaking areas per Flexi-Liner instuctions.



A two person team is more efficient: one to apply soap, the other to operate the Inspection Box. The testing operation can usually cover 5 or 6 feet per minute.

Note: Wash the viewing port with a mild soap or detergent (e.g. 409 household cleaner) and lukewarm water, using a clean sponge or soft cloth. Rinse well with clean water. Dry thoroughly with a chamois or moist cellulose sponge to prevent water spots.

FLEXI LINER CORPORATION

MAIN OFFICE
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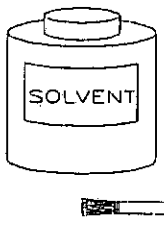
Post Office Box 1070 • Azusa, California 91702-1070
Phone 1-800/423-4909 U.S.A. & CA **Fax** 1-800/356-4648 U.S.A. & CA
1-818/969-7702 1-818/969-7369
TECHNICAL REPRESENTATIVES LOCATED IN MOST MAJOR AREAS IN THE U.S.A. AND CANADA.

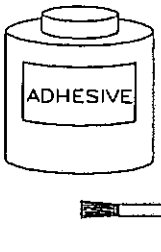
FIELD REPAIR

MATERIALS NEEDED FOR SMALL PATCHING:

1. 

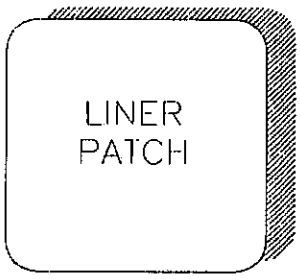
CLEANING SOLVENT (SEE MSDS SHEET FOR CAUTIONS AND HANDLING)

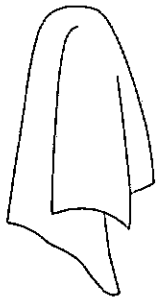
CAP WITH BUILT-IN BRUSH

2. 

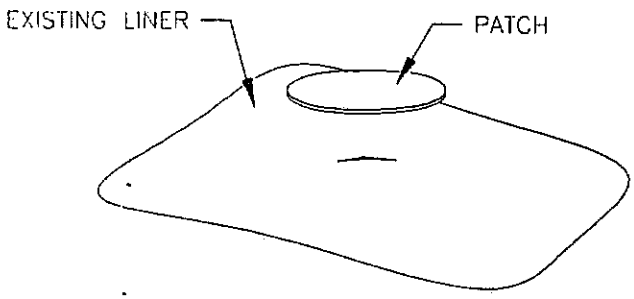
ADHESIVE

CAP WITH BUILT-IN BRUSH

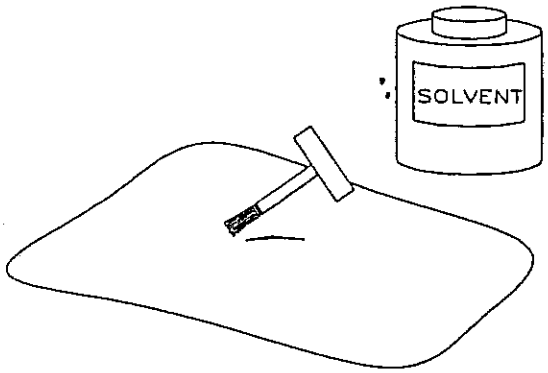
3. 

4. 
CLEAN, DRY CLOTH

REPAIR PROCEDURE



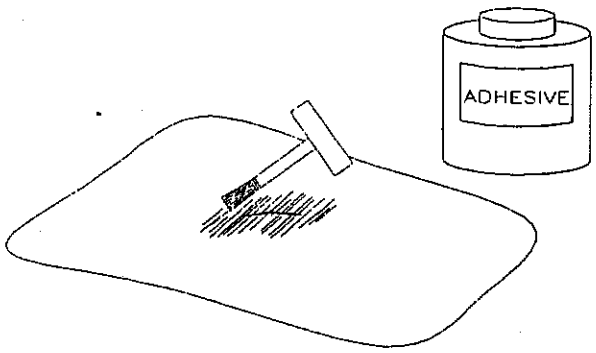
1. CUT A PATCH AT LEAST 1" LARGER ON ALL SIDES OF DAMAGED AREA.



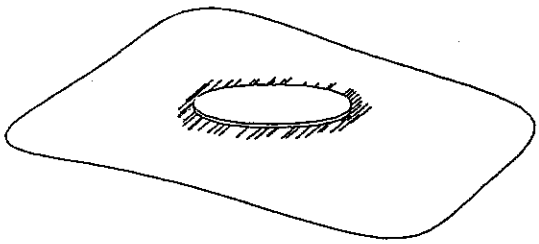
2. CLEAN DAMAGED AREA AND PATCH WITH SOLVENT WIPE WITH A CLEAN DRY CLOTH IF NECESSARY. WAIT A FEW MINUTES FOR SOLVENT TO EVAPORATE.

DR. .N BY: TRG		THE LINER WITH EXPERIENCE 165 ASPAN AVE.-AZUSA, CA 91702-4234 P.O. BOX 1070-AZUSA, CA 91702-1070 PHONE (818) 969-7702 PHONE (800) 423-4909 USA, CANADA, & MEXICO FAX (818) 969-7369 FAX (800) 356-4648 USA, CANADA, & MEXICO	CUSTOMER: REPAIR KIT PROCEDURE FOR SMALL PATCHES P.O.# SO.#
SCALE: NONE	DRAWING NUMBER		
DATE: 08/24/92	PATCH1		

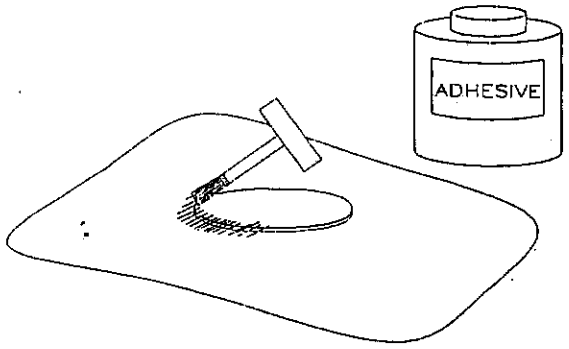
REPAIR PROCEDURE – CONT.



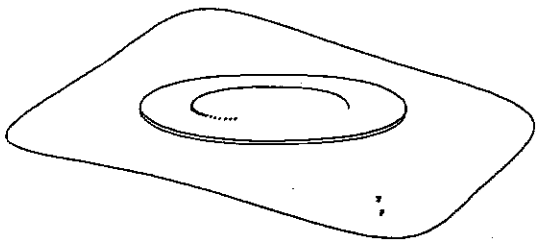
3. APPLY A THIN LAYER OF ADHESIVE TO DAMAGED AREA. COVER AN AREA LARGER THAN THE PATCH.



4. PLACE PATCH OVER DAMAGED AREA AND APPLY EVEN WEIGHT OR DIRECT PRESSURE FOR APPROX. 5 MINUTES.



5. APPLY EXTRA GLUE AROUND THE EDGES OF THE PATCH.



6. FOR EXTRA PROTECTION, REPEAT STEPS 1–5 WITH A LARGER PATCH DIRECTLY OVER THE TOP OF THE FIRST PATCH.

7. BEFORE REFILLING THE TANK, WAIT ABOUT 1/2 HOUR (DEPENDING ON TEMPERATURE AND HUMIDITY) TO ALLOW GLUE TO BOND FULLY. INCREASING THE TEMPERATURE OF LINING AROUND THE PATCH SPEEDS UP THE BONDING PROCESS.

DRAWN BY: TRG	"THE LINER WITH EXPERIENCE"	CUSTOMER:	
SCALE: NONE / DRAWING NUMBER	FLEXI LINER CORPORATION	REPAIR KIT PROCEDURE FOR SMALL PATCHES	
DATE: 08/24/92 / PATCH2	165 ASPAN AVE.-AZUSA, CA 91702-4234 P.O. BOX 1070-AZUSA, CA 91702-1070 PHONE (818) 969-7702 PHONE (800) 423-4909 USA, CANADA, & MEXICO FAX (818) 969-7369 FAX (800) 356-4648 USA, CANADA, & MEXICO	P.O.#	SO.#

MATERIAL SAFETY DATA SHEET
TETRAHYDROFURAN

SECTION I - PRODUCT IDENTIFICATION

GENERAL OR GENERIC ID: ETHER
DOT HAZARD CLASSIFICATION: FLAMMABLE LIQUID (173.115)

SECTION II - COMPONENTS

IF PRESENT, IARC, NTP AND OSHA CARCINOGENS AND CHEMICALS SUBJECT TO THE REPORTING REQUIREMENTS OF SARA TITLE III SECTION 313 ARE IDENTIFIED IN THIS SECTION.

INGREDIENT	%(by WT)	PEL	TLV	Note
TETRAHYDROFURAN CAS #: 109-99-9	>95	200 PPM	200 PPM	(1)

Notes:
(1) ACGIH - SHORT TERM EXPOSURE LIMIT (STEL) FOR TETRAHYDROFURAN IS 250 PPM.

SECTION III - PHYSICAL DATA

BOILING POINT	FOR PRODUCT	151.00 DEG.F (66.11 DEG.C) @ 760.00 mm Hg
VAPOR PRESSURE	FOR PRODUCT	143.00 mm Hg @ 68.00 DEG.F (20.00 DEG.C)
SPECIFIC VAPOR DENSITY	AIR = 1	2.4
SPECIFIC GRAVITY		.883 @ 68.00 DEG.F (20.00 DEG.C)
PERCENT VOLATILES		100.00%
EVAPORATION RATE	(N-BUTYL ACETATE = 1)	8.00

SECTION IV - FIRE AND EXPLOSION INFORMATION

FLASH POINT (TCC) -6.0 DEG.F (-21.1 DEG.C)

EXPLOSIVE LIMIT (PRODUCT) LOWER - 2.0%

EXTINGUISHING MEDIA: REGULAR FOAM OR CARBON DIOXIDE OR DRY CHEMICAL

HAZARDOUS DECOMPOSITION PRODUCTS: MAY FORM TOXIC MATERIALS: CARBON DIOXIDE AND CARBON MONOXIDE, VARIOUS HYDROCARBONS, ETC.

FIRE FIGHTING PROCEDURES: WEAR SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN THE POSITIVE PRESSURE DEMAND MODE WHEN FIGHTING FIRES.

SPECIAL FIRE & EXPLOSION HAZARDS: MATERIAL IS HIGHLY VOLATILE AND READILY GIVES OFF VAPORS WHICH MAY TRAVEL ALONG THE GROUND OR BE MOVED BY VENTILATION AND IGNITED BY PILOT LIGHTS, OTHER FLAMES, SPARKS, HEATERS, SMOKING, ELECTRIC MOTORS, STATIC DISCHARGE, OR OTHER IGNITION SOURCES AT LOCATIONS DISTANT FROM MATERIAL HANDLING POINT.

DRY ETHER READILY FORMS EXPLOSIVE PEROXIDES WITH AIR.

NEVER USE WELDING OR CUTTING TORCH ON OR NEAR DRUM (EVEN EMPTY) BECAUSE PRODUCT (EVEN JUST RESIDUE) CAN IGNITE EXPLOSIVELY.

ALL FIVE GALLON PAILS AND LARGER METAL CONTAINERS INCLUDING TANK CARS AND TANK TRUCKS SHOULD BE GROUNDED AND/OR BONDED WHEN MATERIAL IS TRANSFERRED.

NFPA CODES: HEALTH- 2 FLAMMABILITY- 3 REACTIVITY- 0

MATERIAL SAFETY DATA SHEET - TETRAHYDROFURAN (CONT.)

SECTION V - HEALTH HAZARD DATA

PERMISSIBLE EXPOSURE LEVEL 200 PPM
THRESHOLD LIMIT VALUE 200 PPM

EFFECTS OF ACUTE OVEREXPOSURE: FOR PRODUCT
EYES - CAUSES IRRITATION, BURNS IF NOT REMOVED
SKIN - PROLONGED OR REPEATED CONTACT CAN CAUSE MODERATE IRRITATION
BREATHING - EXCESSIVE INHALATION OF VAPORS CAN CAUSE NASAL AND RESPIRATORY AND CENTRAL NERVOUS SYSTEM EFFECTS INCLUDING DIZZINESS, WEAKNESS, FATIGUE, NAUSEA, HEADACHE AND POSSIBLE UNCONSCIOUSNESS.
SWALLOWING - CAN CAUSE GASTROINTESTINAL IRRITATION, NAUSEA, VOMITING, AND DIARRHEA.FIRST AID:
IF ON SKIN: THOROUGHLY WASH EXPOSED AREA WITH SOAP AND WATER. REMOVE CONTAMINATED CLOTHING. LAUNDER CONTAMINATED CLOTHING BEFORE RE-USE.
IF IN EYES: FLUSH WITH LARGE AMOUNTS OF WATER, LIFTING UPPER AND LOWER LIDS OCCASIONALLY, GET MEDICAL ATTENTION.
IF SWALLOWED: DO NOT INDUCE VOMITING. IMMEDIATELY DRINK TWO GLASSES OF WATER. NEVER GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON. CALL PHYSICIAN OR TRANSPORT TO AN EMERGENCY FACILITY.
IF BREATHED: IF AFFECTED, REMOVE INDIVIDUAL TO FRESH AIR. IF BREATHING IS DIFFICULT, ADMINISTER OXYGEN. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. KEEP PERSON WARM, QUIET AND GET MEDICAL ATTENTION.

PRIMARY ROUTE(S) OF ENTRY:
INHALATION, SKIN CONTACT

EFFECTS OF CHRONIC OVEREXPOSURE: OVEREXPOSURE TO THIS MATERIAL (OR ITS COMPONENTS) HAS APPARENTLY BEEN FOUND TO CAUSE THE FOLLOWING EFFECTS IN LABORATORY ANIMALS: LIVER ABNORMALITIES, KIDNEY DAMAGE.

SECTION VI - REACTIVITY DATA

HAZARDOUS POLYMERIZATION: CAN OCCUR -- POLYMERIZATION CAN OCCUR IN THE PRESENCE OF CATIONIC INITIATORS SUCH AS SELECTED LEWIS ACIDS OR STRONG PROTON ACIDS.

STABILITY: STABLE -- CAN FORM POTENTIALLY EXPLOSIVE PEROXIDES UPON LONG STANDING IN AIR.

INCOMPATIBILITY: AVOID CONTACT WITH STRONG OXIDIZING AGENTS.

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED:
SMALL SPILL: ABSORB LIQUID ON PAPER, VERMICULITE, FLOOR ABSORBENT, OR OTHER ABSORBENT MATERIAL AND TRANSFER TO HOOD.

ELIMINATE ALL SOURCES OF IGNITION SUCH AS FLARES, FLAMES (INCLUDING PILOT LIGHTS), AND ELECTRICAL SPARKS.

VENTILATE AREA.

LARGE SPILL: ELIMINATE ALL IGNITION SOURCES (FLARES, FLAMES INCLUDING PILOT LIGHTS, ELECTRICAL SPARKS). PERSON NOT WEARING PROTECTIVE EQUIPMENT SHOULD BE EXCLUDED FROM AREA OF SPILL UNTIL CLEAN-UP HAS BEEN COMPLETED. STOP SPILL AT SOURCE, DIKE AREA OF SPILL TO PREVENT SPREADING, PUMP LIQUID TO SALVAGE TANK. REMAINING LIQUID MAY BE TAKEN UP ON SAND, CLAY, EARTH, FLOOR ABSORBENT, OR OTHER ABSORBENT MATERIAL AND SHOVELED INTO CONTAINERS.

PREVENT RUN-OFF TO SEWERS, STREAMS OR OTHER BODIES OF WATER. IF RUN-OFF OCCURS, NOTIFY PROPER AUTHORITIES AS REQUIRED, THAT A SPILL HAS OCCURRED.

WASTE DISPOSAL METHOD:
SMALL SPILL: ALLOW VOLATILE PORTION TO EVAPORATE IN HOOD. ALLOW SUFFICIENT TIME FOR VAPORS TO COMPLETELY CLEAR HOOD DUCT WORK. DISPOSE OF REMAINING MATERIAL IN ACCORDANCE WITH APPLICABLE REGULATIONS.

LARGE SPILL: DESTROY BY LIQUID INCINERATION

CONTAMINATED ABSORBENT MAY BE DEPOSITED IN A LANDFILL IN ACCORDANCE WITH LOCAL, STATE AND FEDERAL REGULATIONS.

SECTION VIII - PROTECTIVE EQUIPMENT TO BE USED

RESPIRATORY PROTECTION: IF WORKPLACE EXPOSURE LIMIT(S) OF PRODUCT OR ANY COMPONENT IS EXCEEDED (SEE SECTION II), A NIOSH/MSHA APPROVED AIR SUPPLIED RESPIRATOR IS ADVISED IN ABSENCE OF PROPER ENVIRONMENTAL CONTROL. OSHA REGULATIONS ALSO PERMIT OTHER NIOSH/MSHA RESPIRATORS (NEGATIVE PRESSURE TYPE) UNDER SPECIFIED CONDITIONS (SEE YOUR SAFETY EQUIPMENT SUPPLIER). ENGINEERING OR ADMINISTRATIVE CONTROLS SHOULD BE IMPLEMENTED TO REDUCE EXPOSURE.

VENTILATION: PROVIDE SUFFICIENT MECHANICAL (GENERAL AND/OR LOCAL EXHAUST) VENTILATION TO MAINTAIN EXPOSURE BELOW TLV(S).

PROTECTIVE GLOVES: WEAR RESISTANT GLOVES SUCH AS: POLYVINYL ALCOHOL

EYE PROTECTION: CHEMICAL SPLASH GOGGLES IN COMPLIANCE WITH OSHA REGULATIONS ARE ADVISED; HOWEVER, OSHA REGULATIONS ALSO PERMIT OTHER TYPE SAFETY GLASSES. (CONSULT YOUR SAFETY EQUIPMENT SUPPLIER)

OTHER PROTECTIVE EQUIPMENT: TO PREVENT REPEATED OR PROLONGED SKIN CONTACT, WEAR IMPERVIOUS CLOTHING AND BOOTS.

SECTION IX - SPECIAL PRECAUTIONS OR OTHER COMMENTS

CONTAINERS OF THIS MATERIAL MAY BE HAZARDOUS WHEN EMPTIED SINCE EMPTIED CONTAINERS RETAIN PRODUCT RESIDUES (VAPOR, LIQUID, AND/OR SOLID), ALL HAZARD PRECAUTIONS GIVEN IN THE DATA SHEET MUST BE OBSERVED.
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